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DICTIONARY

OF

PRACTICAL SURGERY

BY

VARIOUS BRITISH HOSPITAL SURGEONS

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examining a case of simple talipes equinus, the foot will be found to be in a straight line with the leg, neither inverted nor everted, and on attempting to flex the foot on the leg, the tendo Achillis can be felt as a rigid band holding the heel in its raised position. In the majority of these cases nothing else is at fault; but in some, on further examination being made, the arch of the foot is found unduly flexed, and the plantar fascia is to be felt tightly contracted. In some rare cases of an unusually severe nature, the tendon of the posterior tibial or those of the peronei muscles will be noticed preventing the foot being placed in its natural position. In addition to these causes of talipes equinus, in many cases there is considerable stiffness of the ankle-joint, with a contracted state of the ligaments around the joint. This will be found to vary greatly in each case, and in some to be entirely absent.

The *Treatment* of talipes equinus consists in the subcutaneous division of the abnormally contracted tendons and fascia, and, after the punctures made by the tenotome are healed, the gradual extension of the foot by means of a Scarpa's shoe. The amount of force to be used must depend on the resistance caused by the adhesions in and around the ankle-joint. In those cases in which, after division of the contracted tendon, the foot can at once be placed in the natural position, great care must be taken to keep the divided ends of the tendo Achillis in apposition until they have partially united, and to extend with caution, lest the tendon become overstretched and the case be converted into one of talipes calcaneus. It must be observed, moreover, that when the plantar fascia as well as the tendo Achillis is contracted, it must be divided *first*, as the resistance offered by the contracted tendo Achillis offers the necessary resistance which is required in stretching it. After division of the tendo Achillis, the patient should not be allowed to rest on the foot for at least six weeks, lest the tendon become unduly stretched. After the foot has been brought to its natural position by the means indicated, a boot with a steel support will in most cases be required.

If the case be one of paralysis, and the patient has not the power to flex the foot on the leg, a back-stop must be fixed into the joint of the support, so as to allow the foot to be bent up, but to prevent its falling beyond a right angle with the leg, and the patient should wear the apparatus at night to retain the foot in its proper position, as there is danger of a relapse if this be not done. This deformity being usually due to infantile or other paralysis, it is necessary, when the foot has been brought into a good position, to supplement the weak extensor muscles by some form of elastic support, by which the toes may be raised from the ground in walking. This can be effected either by elastic cords passing from a collar below the knee, supported by a light outside steel from the foot; or, better, a double-curved steel spring can be attached to the outside steel, so as to keep the foot flexed when the weight of the body is not thrown on the toes.

TALIPES CALCANEUS (in which the heel is depressed and the toes are raised, so that the patient walks on the posterior end of the os calcis) may be conveniently divided into two varieties: (1) True; (2) False. The first kind is well illustrated in congenital cases, when the foot is fixed in its deformed position, and the tendons of the muscles that flex the foot on the leg will be found to be contracted, at the same time that the tendo Achillis is elongated. This variety may also be produced by burns, which leave a cicatrix on the anterior surface of the ankle-joint.

The false variety is by far the more common, and is the result of paralysis of the gastrocnemius muscle. In these cases the tendo Achillis is much lengthened, and the dorsum of the foot can be placed on the front of the leg without any resistance being offered; but there is no contraction of the tendons in front of the ankle-joint. The plantar fascia is generally much contracted. This state of deformity is sometimes produced after division of the tendo Achillis, when sufficient care has not been taken in the after-treatment, and the tendon has consequently become too much elongated.

In the congenital cases, a cure may usually be effected without the division of tendons, by rubbing the anterior surface of the ankle-joint with some oily liniment, and stretching the foot away from the leg and retaining it in position by means of a padded flexible iron splint, at the required angle.

The *Treatment* generally adopted for the relief of the paralytic cases is to have a support fixed to the boot so that an elastic band may be placed at the back of the ankle, in order in some degree to compensate for the loss of power in the gastrocnemius muscle. When the plantar fascia is contracted, it should be divided, and the contraction of the sole overcome by means of a Scarpa's shoe, having a divided sole with a cog-wheel, and a strap that can be fixed over the front of the foot. This is necessary, as there is no contracted tendo Achillis to work against, as in cases of ordinary talipes equinus. In the case of contracted cicatrix after a burn, the treatment is the same as in the case of similar cicatrices in other parts of the body.

Talipes Varus (in which the inner edge of the foot is drawn upwards, and the anterior two-thirds of the foot are twisted inwards, and the outer edge rests on the ground) is so seldom met with, apart from talipes equinus, that, to save repetition, it will be considered under the heading of talipes equino-varus.

Talipes Valgus (in which the outer edge of the foot is drawn upwards, so that the patient rests on the inside of his foot and inner ankle) is so generally combined with flat-foot that it will be most convenient to consider them together. The congenital form of valgus is not very common; but when it does occur it is of a somewhat severe type, the sole of the foot being slightly convex, while the foot is held in its deformed position by the peroneus longus and brevis. The treatment of these cases is to stretch the foot towards the position of talipes varus, and to retain it there by means of a flexible splint, bandaged to the inside of the foot and leg. If this is found not to be sufficient to overcome the deformity, the tendons of the peroneus longus and brevis must be divided. When the child begins to walk, a steel sole-plate, with an india-rubber pad fixed to it, must be worn in the boot to support the displaced bones of the tarsus, so that in time the patient may regain the natural arch of the instep.

Cases of paralytic valgus are sometimes met with in which there is no flat-foot, and division of the peronei tendons may or may not be necessary, according to whether they are tightly contracted. In either case, a boot with an iron support attached to the outside of the sole, and with a band round the calf, must be worn, and a leather strap with two ends (T-strap) must be fixed to the inside of the boot just below the internal malleolus. The two ends are buckled round the ankle so as to include the iron support, and these pull the foot into its natural position, and retain it there. In addition to these cases of talipes valgus, either congenital or caused by paralysis, many others of a similar nature are met with in various degrees of severity, from a slight sinking of the arch of the foot, to those in which there is even convexity of the inner border of the sole, and in which the inner malleolus nearly touches the ground. In such cases the foot is firmly held in this deformed position by the contracted tendons of the peroneus longus and brevis, and, in the very worst examples, by the extensor longus digitorum and the peroneus tertius.

These cases, for the most part, begin in growing youths and girls, and are brought to the severer type by constant standing or carrying heavy weights. The treatment depends upon the stage in which the deformity presents itself, and cases may be placed under three heads.

1st. On the patient standing up, the whole of the bottom of the foot will be seen to touch the ground, but little or no valgus will be observed. On examination there will be found to be no stiffness in the ankle-joint, and the foot can be freely moved in all directions. The treatment consists in the use of a boot with a wide and flat heel, into which is placed a steel plate, with a pad attached to its inner border, to press up the fallen arch when the patient stands up upon it. It is necessary that the pad should be fixed to a steel plate, or it will be pushed inwards, and becomes useless.

2nd. In the second class, in addition to the flatness of the foot, its outer side is drawn upwards, and the inner malleolus nearly touches the ground. On manipulation, however, the foot can be inverted without resistance. In the treatment of this kind a sole-plate must be worn, as in the first kind; but, in addition, two cross-straps must be fixed to the inner side of the boot, one passing over the ankle, and the other at the back of the ankle, and buckled over, and just above, the external malleolus.

3rd. In this, the most severe form of talipes valgus, the foot will be found on examination to be in the same position as that just described, but the deformity will be somewhat more marked. The chief difference between them, however, is that the foot is firmly held in its deformed state, so much so that it is sometimes thought to be ankylosed at the ankle-joint, and severe pain is complained of around this joint, especially after standing or walking. On an attempt being made to draw the foot inwards, the tendons of the peroneus longus and brevis, and, in many cases, also the tendons of the extensor longus digitorum and peroneus tertius, will be found rigidly contracted. Although this is the most painful of all forms of club-foot, it is, perhaps, the most satisfactory to treat, for after complete division of the contracted tendons, the foot can be placed without difficulty in its natural position, and, with the use of good boots with sole-plates, the patient is freed from all pain, and able to return to his former occupation. After the tendons mentioned above have been divided, the treatment requires the use of no special instrument, as the necessary extension can be efficiently carried out by means of a padded flexible splint bandaged to the inner side of the leg and foot. If the extensor longus digitorum has been divided, the extension should not be too rapidly proceeded with. The patient may be allowed to walk six weeks after the tenotomy, but it will be necessary that he should wear, as well as a sole-plate, a steel support on the outer side of the leg, with a T-strap, as explained above. *See* FLAT-FOOT.

TALIPES EQUINO-VARUS is that in which the heel is raised, the inner border of the foot being drawn upwards, and the outer edge resting on the ground. The writer proposes to consider it in detail, as it is the most complex, and requires most care and attention in its treatment.

CONGENITAL TALIPES EQUINO-VARUS IN THE INFANT differs from that of the adult in that it is less severe, as the foot has not been walked on, and the tendons, ligaments, and fascia have not become so greatly developed and contracted in the deformed position. It will, therefore, be best to consider the treatment of the two forms separately, and to take, first of all, the infantile variety.

The treatment must commence with the cure of the varus, and it is necessary that this should be completely accomplished before anything else is attempted. For it is evident that a simple deformity is more easy to cure than a compound one, and it will be found impossible to overcome the equinus while the varus is still present, for the foot being turned inwards, and the tendo Achillis being shifted to the inner side of the ankle-joint, the attempt to stretch it is made at a mechanical disadvantage, and cannot be satisfactorily accomplished. On the other hand, attempts to stretch the tendons and ligaments which hold the foot in the position of varus are made more advantageously the more the tendo Achillis is contracted; and this is proved by the much greater difficulty that is experienced in the treatment of those cases in which the tendo Achillis has been divided before the tibials, under the mistaken idea that they can be afterwards sufficiently stretched to accomplish a cure. Therefore, it is better to perfectly cure the varus first, and thus produce a case of simple equinus, which can afterwards be readily cured. From the time of birth the foot may be advantageously shampooed, and unfolded, as far as possible, by the nurse; but at the age of six weeks, if the infant is in good health, tenotomy should be practised, and systematic treatment of the deformity begun.

If, in a case of talipes equino-varus, an attempt be made to evert the deformed foot on the leg, and the finger be placed on the inner side of the ankle-joint, the tendon of the tibialis anticus will be readily felt as a tight cord holding the foot in its deformed position. If still greater force be used, and the finger be placed on the inner side of the leg, just behind the edge of the tibia, about an inch above the tip of the malleolus, a slight movement will be felt under the finger, indicating the position of the tendon of the tibialis posticus, more or less distinct according to the extent of the contraction and the amount of subcutaneous fat. Lying very near this is the tendon of the flexor longus digitorum; but this cannot be felt.

The first stage of the operation for the cure of talipes equino-varus consists in the division of these tendons. This having been done—as described in the article on TENOTOMY—after the foot has been kept at rest for four days, and the punctures are healed, a flexible splint, six inches long and one inch broad, carefully padded, must be slightly bent so as to make the padded side somewhat concave; it is to be applied to the *outside* of the foot, and bandaged on, so as to draw the foot into a rather straighter position, but not to cause pain to the child. In three or four days the splint is to be taken off, and having been made somewhat straighter, again applied. This is to be continued at about the same interval until the foot can be placed *quite* straight, or, better still, can be bent a little in the direction opposite to that of the original deformity. In ordinary cases this can be accomplished in three weeks.

In the more severe examples of this deformity, however, it will be found that progress cannot be made at such a quick rate. These are the cases in which the heels will be found to be very small and flat, and the foot to have a more rounded appearance than is common. In these cases stretching must be carried out for a longer time, and the foot must occasionally, at intervals of a few days, be suddenly wrenched, either with or without chloroform. When at last the foot can be placed quite straight, it is advisable to keep it in that position for a prolonged time, a month or six weeks, before the treatment is proceeded with.

Having proceeded so far with the case, the sole of the foot should be carefully examined to see if there is any undue contraction of the plantar fascia, and if such be found, the fascia must be divided. In the less severe cases this will not be necessary. In the case of an infant, the tendo Achillis may be divided at the same time.

It is now necessary to decide upon the form of instrument which is to be employed for the further treatment of the case, as this must be measured for, and got ready to be applied, four or five days after the division of the tendo Achillis. If the deformity is not unusually severe, a simple one may be adopted. It is made of sheet-iron, covered with washleather, and consists of a trough for the leg, and a foot-piece at right angles with it, with a leather ankle-strap to keep the heel down, and two webbing straps. One of these is fastened round the leg, and the other goes round the toes and keeps the foot everted. There are no cog-wheels, and, in consequence, this instrument is cheap. Supposing, then, the case to be a simple one, on the fourth or fifth day after the tendo Achillis has been divided, the foot having been bandaged, the instrument is to be applied by thrusting the heel into it, and the leather strap being fixed over the front of the ankle, it is to be drawn as tight as possible and buckled, and the other straps are to be fastened. If the child should suffer much at night, the leather strap may be loosened by one hole and fastened up again in the morning. This, however, is not often necessary, as leather straps always stretch somewhat. Every two or three days the splint must be removed; when the foot will be found to be improved in position, and when the splint is reapplied the leather strap will be able to be tightened by another hole. The heel will also be found to go gradually into its place on the sole-plate of the instrument as this treatment is continued.

After three weeks the splint should be removed every night and morning, and at first the surgeon, and then the nurse, should gently work the foot up and down, care being taken that sufficient force is not used to rupture the newly formed tendon. When this has been done, the splint must be at once replaced, and a thin pad may be placed under the joints of the toes, so that on tightening the heel-strap the foot may be further flexed on the leg. In two or three months the foot will have grown into a natural shape, and move quite freely at the ankle-joint. It should now be left out of the splint for a short time each day, to allow the child to exercise its muscles, and frictions with a simple liniment may be made use of. It must be remembered, however, that in all these cases there is so much danger of relapse that the patient must be watched for the first symptoms of stiffness returning. The child must go on in this way until old enough to walk, and it must then wear irons inside the ankle and leg, and extending round the waist. It is necessary to make the supports extend to the waist, as there is always rotation inwards at the knees, which cannot be overcome by any other means.

In the more severe cases of infantile talipes equino-varus the treatment is the same as that for cases which have been left untreated until after the child can walk.

Congenital Talipes Equino-Varus after the Period of Infancy.—The treatment of talipes equino-varus, after the period of infancy, may be conveniently divided into three parts: 1st. The cure of the simple infantile varus occasioned only by the contraction of the tibialis posticus, flexor longus digitorum, and the tibialis anticus. 2nd. The cure of the remaining acquired varus, caused by the contraction of the abductor pollicis, plantar fascia, and the various ligaments connected with the misshapen bones of the tarsus. 3rd. The cure of the equinus caused by the contracted tendo Achillis. With regard to the treatment of the first part, the tendons of the tibialis posticus, flexor longus digitorum, and the tibialis anticus must be divided, and after the tenotomy punctures are healed, a wooden, padded, outside splint, extending from the knee to the end of the toes, and with an extra pad just above the external malleolus, must be applied, to which the foot is gradually drawn by means of an ordinary bandage. Great care must be taken lest a sore form on the outer side of the foot, and, if the skin on this part is observed to become red and tender, all pressure must be removed and the splint be discontinued for a day or two. In addition to the gradual stretching by these means, it is well occasionally to *forcibly* twist the foot outwards, and so to rupture any tense fibres of ligament that hold the foot in its deformed position. This treatment must be persevered in until the foot is perfectly straight and in a line with the leg, when the second part may be proceeded with. This is, of all, the most difficult to accomplish even after complete division of the abductor pollicis and the plantar fascia, chiefly on account of the great danger of producing sloughs by such an amount of pressure as will suffice to correct the deformity. The common Scarpa's shoe, useful as it is in some forms of talipes, is quite useless here.

For the efficient application of force in overcoming the resistance formed by the contracted tissues on the concave aspect of the deformed tarsus, the fulcrum must be placed on some part of its convexity, and as near as possible to its most projecting point; the internal tubercle of the os calcis being made a fixed point, and the power being represented by the tension of a strap placed round the ball of the great toe to draw it outwards. The problem, therefore, to be solved is: How can the fulcrum be applied in this position for the required length of time without causing sloughs? The only method is by rendering it a *movable* one. In other words, the pad which forms the fulcrum, instead of being a fixed part of the instrument, should be unconnected with it and thus made capable of being shifted from point to point along the outer edge of the tarsus and leg, as circumstances require. An instrument for carrying this into execution was explained and figured in the *Lancet* of May 3, 1879. One of the chief advantages of this instrument is, that it prevents *rotation* of the foot, and it can also be used for carrying out the third stage of the treatment, viz. correcting the equinus, after the division of the tendo Achillis, by means of a cog-wheel attached behind the heel.

TALIPES EQUINO-VARUS CAUSED BY PARALYSIS, &c.—Although the amount of deformity in each case will be found to vary greatly, from the slightest deviation from the normal state to a condition as severe as in a congenital case, the treatment of these two varieties of club-foot is in many respects identical. Each patient must be carefully examined to determine what are the tendons or fascia that keep the foot in its deformed position. This is done by trying to force the foot into its natural position. In some cases this can be accomplished without any resistance being offered, and then it is only necessary that the patient should wear an *inside* iron and strap. In other cases, on the contrary, the same tendons and fascia which it is necessary to divide in a congenital case must be operated on. It should be remembered that the posterior tibial when contracted, causes equinus as well as varus, and in many cases the former deformity cannot be overcome unless it is properly divided.

In some examples of this deformity, after division of the tendo Achillis, the foot hangs quite loosely at the ankle-joint and with the slightest amount of pressure goes up to the position of calcaneus. When this happens, no special instrument is required for the treatment, but the foot must be kept a sufficiently long time in the position of equinus until the tendon unites, when it must be stretched with great care. This can be done by means of a flexible splint and bandage. In severe cases the details of the treatment are the same as required for congenital cases, and the same instrument must be used.

TALIPES EQUINO-VALGUS (when the foot is turned out and the heel drawn up) is rarely if ever met with as a congenital deformity. In several instances of talipes equinus caused by paralysis, after division of the tendo Achillis, the foot will be observed to have a tendency to turn *out*. This can generally be sufficiently treated by placing an iron on the *outside* of the leg and foot, and having a strap attached to the inside of the boot, passing round it. It must be remembered, however, that the peroneus longus and brevis when contracted can cause equinus as well as valgus, and in some cases it is necessary to divide them.

TALIPES CALCANEO-VARUS (when the heel is depressed and the foot turned in) is a very rare deformity, and requires no separate description.

TALIPES CALCANEO-VALGUS (in which the heel is depressed and the foot turned out). In nearly all cases of talipes calcaneus the foot is more or less turned out. The treatment is generally the same as that made use of for talipes calcaneus. The steel support attached to the boot must be on the *outside* of the leg. HENRY F. BAKER.

CLUB-HAND. *See* HAND, Surgery of the.

CNIDOSIS. *See* URTICARIA.

COCCYDYNIA, a painful and often very obstinate affection of the region of the coccyx, described first by Dr. J. C. Nott, of New York, in 1844, and more fully by Sir James Simpson in 1859. Its marked symptom is severe neuralgic pain, radiating from the sacro-coccygeal joint, and like in its intensity and its general effects to the pain caused by fissure of the anus. It is due in many instances to some slight injury occurring during delivery, or to some uterine or ovarian disturbance, and therefore is most frequently met with in women. In some few cases, however, it has been observed in men and also in young children. It may be caused by displacement of the coccyx either backwards or forwards, by injury to this region causing a sprain, by excessive horse-exercise, or simply by the application of cold to the region. In a well-marked case the patient suffers much from constant pain, with paroxysmal attacks of almost intolerable suffering, and is obliged when sitting to rest the weight of the body on one or the other tuber ischii, and often is unable to walk or even to stand upright. The affection in some instances is a very transient one, and in others persists in spite of varied and active treatment. For the treatment of the latter class of cases, Sir James Simpson recommended subcutaneous division of all the muscles connected with the coccyx. This operation has been practised with some success; but in most instances the affection remains intractable, and neither myotomy nor extirpation of the coccyx, a method devised by Dr. Nott, can afford any decided benefit.

W. Johnson Smith.

COCCYX, Dislocations of the, are generally of an incomplete kind. They may occur *backwards*, as the result of parturition, or *forwards*, from kicks or falls in a sitting posture. Reduction is easily effected by pressure, the finger being placed in the rectum to reduce the forward displacement. Prolonged coccydynia is apt to follow, owing to the impossibility of securing complete rest, and to the implication of the nerves in the inflammatory thickening which results.

R. Clement Lucas.

COCK'S OPERATION. *See* Boutonnière, the Operation of.

COLD is a therapeutic agent of varied and great usefulness in the surgeon's hands. It may be applied in the moist or dry state,—alone, or in combination with other remedial measures.

Cold acts, according to the manner and degree of its application, as an *anæsthetic*, *antiphlogistic*, *antiseptic*, *hæmostatic*, or *tonic*. The anæsthetic power of cold is due to the numbness and insensibility which attend the freezing of living tissues. The simplest method of securing that result is to crush a piece of ice in a cloth, by blows with a mallet, or by a tread under the heel of the boot; then, adding to the ice about half its weight of salt, to hold the mixture in a muslin bag on the part to be rendered insensible. A more elegant method is that suggested by Dr. B. Richardson—a hand-ball spray, and pure anhydrous ether. Tissues so frozen may be cut painlessly, but their hardened state is inconvenient if any fine dissection be required.

The antiphlogistic power of cold, long and justly in repute, has been greatly extended since it has become the practice to apply ice in india-rubber bags. Professor Esmarch, the leading advocate of this treatment, has thus expressed himself:—'Of all remedies which are at our command in the treatment of inflammatory processes, cold is the most important; without this remedy he would rather not be a surgeon.' The two great features in the inflammatory process are, increased afflux of blood and rise in temperature; and it is by controlling these, physically and vitally, that cold exercises its antiphlogistic power, all the more effectually when combined with position and rest.

Injuries of the head, which are so greatly benefited by cold, offer wide scope for ingenuity in practical details, applicable to other parts of the body. Nothing can be more effectual than pounded ice in an india-rubber bag, which may be suspended by a tape or bandage, to secure contact with the scalp without oppressive weight. In the absence of an india-rubber bag, the bladder of an ox or large pig answers the purpose; but as the animal membrane is a superior conductor, it lowers the temperature of the part and melts the ice more quickly than when it is enclosed in an india-rubber bag. Hence, ice in animal membranes requires closer watching and more frequent renewal, to ensure the great requisites of comfort, continuity, and safety. In the absence of a bladder the head may be cooled by wetting it lightly from time to time with water, alone or mixed with spirit, and blowing on it with the mouth, a fan, or bellows, to accelerate evaporation. To keep the patient comfortable and at rest, while cold is being applied, the bed and pillows should be kept dry with waterproof sheeting, linen cloths, or absorbent tissue. In some cases, especially in strangulated hernia and swollen joints, the even pressure of a well-adjusted ice-bag adds greatly to the efficacy of cold, which may be applied by other methods, e.g. coils of india-rubber tubing, Leiter's metallic coil, irrigation in a variety of ways based on syphon action; water, snow, or pounded ice in bottles; or metal cases which may be made to fit any part, after moulded patterns.

In the absence of spinal appliances, it is well to bear in mind the simple teaching of Abernethy:—'Wetting the surface of the skin, whilst it is freely exposed to the air, by passing a sponge dipped in common water over it at regular intervals, and thus maintaining constant evaporation, is one of the most powerful of all the modes of reducing temperature.'

A very useful cold lotion may be prepared by dissolving in a pint of water half an ounce of nitre, two drachms of sal ammoniac, and three tablespoonfuls of vinegar, or methylated spirits of wine. By increasing the proportions of nitre and sal ammoniac to five ounces each in the pint of water, a frigorific mixture is produced, which, on emergency, acts as a good substitute for ice. To make an *ice poultice*—of special value in the treatment of thoracic and abdominal injuries—spread a layer of linseed, about an inch thick, on a piece of cloth or absorbent tissue; on it, at regular intervals of an inch or more, place lumps of ice about the size of small walnuts, sprinkle with meal, cover with another cloth, and fold in the edges ready for application. The general preference to which dry cold is entitled, is exceptionally established when it is deemed advisable to apply cold outside bandages. If these be wetted after application they may shrink, so as to produce an amount of constriction which has been known to result in gangrene of the subjacent parts.

The *antiseptic* power of cold is a corollary of its antiphlogistic influence, and is most marked when dry cold is used. Warmth and moisture are powerful factors in animal putrefaction, to which by parity of reasoning, confirmed by experience, cold and dryness are opposed. So, too, by stimulating the contractility of the vascular coats, cold acts as a hæmostatic, all the more effectually if associated with the elevated position, to retard the arterial, and accelerate the venous, current.

Of the tonic action of cold, bathing supplies abundant evidence. Patients suffering from piles, varicocele, and generally from weakness in the pelvic regions, often derive very great benefit from cold hip-baths and enemata. Cold to the face and hands is a popular reviver from faints, and deservedly so. A greater degree of cold, than by affusion with water, may be produced by sprinkling ether or eau de Cologne in the palms of the hands, or on the forehead and behind the ears, and blowing on it, to accelerate evaporation. In extreme fainting, from the effects of chloroform or other cause, a lump of ice, the size of a pullet's egg, pressed into the rectum has been known to excite a deep inspiration, and at once revive an apparently moribund person.

Sampson Gamgee.

COLECTOMY.—When resection is practised upon the colon, the proceedings are practically identical with those described under Enterectomy. In colectomy the chief difficulty lies in the selection of the incision through the abdominal parietes. When the obstruction is distinctly diagnosed to be in the ascending or descending colon, no incision is better than that practised for lumbar colotomy. When the obstruction is diagnosed to be situated in the transverse colon, sigmoid flexure, or cæcum, the parietal incision may be made directly over the seat of the occlusion. When the locality of the obstruction cannot be directly determined, an exploratory incision should be made in the middle line. If the resection can be performed through this median incision, it is well. If found to be impossible, the median wound should be closed, and a second incision made in one or other loin, or more directly over the seat of the obstruction. The observations made with regard to the selection of the mode of resection when dealing with enterectomy, apply equally to the operation when performed upon the colon.

The general mortality of resection operations, as estimated from some 130 reported cases, is about fifty per cent.

Frederick Treves.

COLLAPSE is a state of lowered vitality, induced by reflex inhibition, affecting all the functions of the nervous system.

Causes.—1. *Injuries*, sudden and severe, e.g. burns and scalds, the crushing or mangling of a limb, capital operations, lacerations of any large viscus, severe blows on the abdomen or precordial region without any definite lesion. An injury may cause severe shock, irrespective of the pain produced, as is evidenced by operations performed under anæsthetics.

2. Pain, especially when in connection with parts supplied by the sympathetic nerve; thus shock is often considerable in renal or hepatic colic, or in hernia at the moment that strangulation takes place.

3. Hæmorrhage is a great cause of shock. Up to a certain indefinite amount

a patient is able to lose blood without suffering from shock; but when this amount is once exceeded, symptoms of collapse rapidly supervene. Hæmorrhage, even if but slight, is attended by much more serious consequences at the extremes of life than in the middle-aged, also in the anæmic than in the robust.

4. Mental emotion, e.g. sudden fright.

5. Sudden withdrawal of part of the abdominal contents, as by tapping for ascites, emptying of a hyperdistended bladder, occasionally the use of drastic purgatives.

These causes do not act equally on all patients or under all circumstances. Thus, extensive injuries are much more readily borne by children than by adults, by the healthy and vigorous than by the debilitated and diseased. Pain, on the other hand, is very badly borne by children, in whom it is perhaps the most important agent in inducing shock. The state of mind of the patient at the time of injury, exercises an important influence. If he be greatly excited, and his mind preoccupied, the pain felt will be but little, and the shock induced by the *pain* proportionately small. Nevertheless, under such circumstances, the shock induced by the severity and amount of the *injury* is but little lessened, though its oncoming is sometimes postponed. If, however, the mind be in a state of expectancy or dread of the coming danger—for example, if a patient has made up his mind that an operation is likely to prove fatal—shock is proportionately great. The *impression* produced on the patient's mind by the suddenness of the accident, by the tearing and mangling of a limb whilst he is painfully conscious of the mutilation that is taking place, by the sudden transition from an active life to lengthy confinement in bed, greatly increases the amount and intensity of the shock, due probably in part also to loss of blood; and it is on this account that a primary amputation—e.g. of the thigh, for a compound fracture of the leg—is accompanied by infinitely greater shock than a precisely similar operation performed for disease.

Pathology.—The state of shock or collapse is induced by a 'reflex inhibition affecting all the functions of the nervous system,' i.e. for the time being, the influence of the nervous system on the life of the various tissues and organs of the body is suspended to a greater or lesser extent. The various senses are all more or less affected—sight, smell, hearing, touch, and mental power being variously influenced. But it is to the interference with the nervous mechanism of the heart that most of the symptoms—and those the most serious—are due. For, whilst a patient may readily survive any interference with the sense of sight, touch, &c., a sudden slowing, or even stoppage, of the cardiac contractions will cause death, either suddenly or in a comparatively short time. The stopping, or slowing and weakening, of the cardiac contractions is probably due both to a direct influence exercised through the cardiac nerves themselves, and also to the effects of a diminished blood-pressure induced by the loss of tone in the peripheral arteries, through interference with their innervation. The post-mortem appearances after death from shock are slight, but the veins are usually turgid, and, except in cases of hæmorrhage, all the cavities of the heart are full of blood. Rigor mortis is slight, and the blood generally imperfectly coagulated. In death from the collapse induced by severe hæmorrhage, however, the vessels contain but little blood, and the various organs are of a much whiter hue than normal.

Symptoms.—In severe shock the patient is often completely unconscious for a time; and, even though moving his limbs, and with eyes open, may be quite unable to understand anything that is going on around. In cases of less severity, he cannot readily appreciate the meaning of questions, is quite unable to recall to his recollection facts of which he is really well aware, such as his own name or residence; and in yet other cases, whilst answering questions correctly, his memory appears to be lethargic, and his answers are delayed for five or ten seconds or more. The functions of his various organs are in abeyance, his sight is dim, and he feels giddy, there is a humming noise in his ears, he articulates with difficulty, his sense of touch is greatly impaired, he lies in a state of complete prostration, his muscles are powerless to move his limbs, his sphincters may be paralysed, and his eyelids droop. The skin is livid and clammy, the surface temperature, and perhaps that of the whole body, is distinctly lowered. The movements of respiration are very shallow and feeble, occasionally gasping. The pulse is generally frequent and very feeble, often irregular and dicrotous; the sounds of the heart are but faintly heard. In such a condition as this the patient may die within a very short time from the receipt of the original injury; but in other cases, not immediately fatal, where reaction does not take place (*see* Reaction), this state of shock may be prolonged in some of its features for several days, the patient remaining depressed, and never rallying up to the time of his death.

The chief distinction between the symptoms of the collapse induced by hæmorrhage and those induced by injuries unaccompanied by excessive loss of blood is, that in the former the mental functions are but little affected in comparison with the amount of asthenia, and that the skin is white and bloodless instead of livid, as in the latter.

Treatment.—The chief object of treatment is to restore, as rapidly as possible, the functions of the heart and vessels. In order that the heart may act with as little extra labour as possible, the patient must be kept in the recumbent position, and, that the brain may receive sufficient blood, the head must be kept low, and, in bad cases, blood kept from entering the lower extremities by tight bandaging, or by the application of tourniquets to the femoral arteries for a short time. The failing body-temperature must be sustained by wrapping in cotton wool or warm blankets. Cardiac stimulants must be administered. Chief of these is brandy, in quantities not exceeding half an ounce at a time, and the total amount not exceeding three or four ounces during the continuance of the more severe symptoms, for, if these precautions be not taken, vomiting is likely to ensue. In addition to this, and in its place if the patient is unable to swallow, the brandy may be administered as an enema, or ten to fifteen minims of ether may be subcutaneously injected. Hot milk and strong coffee are often useful. Hot fomentations or mustard-blisters should be applied to the feet, and to the epigastric region. In order to further strengthen the cardiac action, digitalis (liquid extract fʒj.), strychnia (liquor. strych. ♏v.), or belladonna (tinct. bell. ♏xx.), may be given, together with the brandy. If pain be a marked symptom—e.g. in burns in children—opium may be administered with excellent results. As soon as the patient can take further nourishment, this should be supplied, at first in but small quantities, and of such a nature as to ensure rapid assimilation—strong beef-tea and essence of beef. Alcohol should be dispensed with as soon as possible, especially where great reaction or traumatic fever is to be expected. In cases of severe injury, where a capital operation is necessary, the patient should be allowed to rally from the extreme collapse, though it is not necessary, or indeed practicable in most cases, to wait for complete reaction. It is in such a condition—generally reached, if at all, within five or six hours (or less), from the time of the accident—that the additional shock of the operation makes the least impression on the system, whilst if the patient die before such a state is reached, the surgeon may congratulate himself on having stayed his hand.

In cases of operations of expediency for long-existing disease, shock may be much lessened by rest in bed and careful attention to the diet for a week or more beforehand.

Anthony A. Bowlby.

COLLES' FRACTURE. *See* Radius, Fractures of the.

COLLODION is a colourless, viscid liquid, produced by dissolving gun-cotton in three-fourths ether and one-fourth rectified spirit. When this compound is spread on the skin rapid evaporation takes place, leaving a dry, adhesive, impermeable, and contractile layer. These physical properties, and its chemical composition, render collodion a very useful antiphlogistic and antiseptic, powerfully instrumental in maintaining rest and exercising equable pressure. Successive layers of collodion, spread with a camel's-hair pencil, and alternated with layers of absorbent muslin, make well-moulded splints, very useful in fractures or wounds of the hand, and exceptionally so in the management of fractures of the nose.

Small wounds do very well under collodion; but, before applying it, all dirt should be removed and bleeding stopped. In larger wounds, strips of gauze or lint, or skeins of cotton, soaked in collodion, and placed like adhesive plaster, are superior to these in assisting sutures to maintain accurate apposition. In removing collodion dressings with the minimum of disturbance, it is important to bear in mind that they are insoluble in water, but very readily so in a mixture of equal parts of ether and alcohol. In an emergency, a little brandy or whisky will be found to soften the dressings, all the more agreeably if previously warmed. In the treatment of swelled testicle and subcutaneous extravasations of blood, collodion is very useful; so also in limited cases of erysipelas, in chilblains, and sore nipples. For these purposes some surgeons give preference to flexile collodion, prepared by adding two drachms of Canada balsam and one drachm of castor oil, or glycerine, to six ounces of collodion. The difference is not very material. In either form, the agent admits of very varied and useful application. SAMPSON GAMGEE.

COLLOID CARCINOMA. *See* CARCINOMA.

COLOBOMA. *See* CHOROID; IRIS.

COLOTOMY.—This operation consists in establishing an artificial anus in the bowel, above the seat of some obstruction. It has been performed in all forms of occlusion of the colon, in cases of simple and malignant stricture, in cases of occlusion of the bowel from simple neoplasms, from the pressure of a tumour external to the gut, from enteroliths and plugging by foreign substances, and from bending of the colon or distortion thereof due to adhesions. It has been practised also in cases of colic intussusception, in volvulus, and in instances where a fistula exists in the bowel which communicates with the bladder, vagina, &c. Colotomy has been performed also to relieve the distress consequent upon the passage of fæcal matter over a cancerous ulcer of the bowel, in instances where no real obstruction existed.

There are two forms of colotomy, lumbar and inguinal; the former is commonly called Amussat's operation and the latter Littre's. In the former the ascending or descending colon is opened in the loin, without wound of the peritoneum. In the latter the cæcum or sigmoid flexure is opened through an incision in the iliac region, which involves a wound of the peritoneum. *See* ATRESIA ANI. Lumbar colotomy is best performed upon the left side, since the descending colon is more fixed than the ascending, has a larger non-peritoneal surface, is less frequently the seat of abnormality, is less often provided with a meso-colon, and involves an artificial anus that is nearer to the natural anus. It happens also that strictures of the colon are much more frequent in the rectum and sigmoid flexure than in any other part of the large intestine.

The operation is thus performed, presuming that the descending colon has to be opened. The proceeding, however, is the same if the right side of the body be selected. The patient is placed upon the right side, and a hard pillow is placed beneath the right loin, so as to render the left loin more prominent. From the centre of the crest of the ilium, a line is drawn with ink vertically upwards to the last rib, which it will touch near its free extremity. An incision, four inches in length, is then made across the line, at right angles to it, and so arranged that the centre of the incision corresponds to the centre of the line. The wound is therefore midway between the iliac crest and the last rib. Amussat advised a vertical incision which corresponded pretty nearly to the aforesaid ink line. The proceeding has, however, been very generally abandoned. Mr. Bryant uses an oblique incision, 'four or five inches long, beginning one and a half inches to the left of the spine, below the last rib, and passing downwards and forwards in front of the anterior spine of the crest of the ilium, with the line of the incision passing obliquely across the external border of the quadratus lumborum about its centre, and taking the same direction as the nerves which traverse this part.' In the transverse wound after the skin and subcutaneous tissues have been divided, the latissimus dorsi muscle is exposed in the incision with a small amount of the external oblique. On dividing this layer, the internal oblique muscle is exposed in the whole length of the wound. When this structure has been cut through, the posterior aponeurosis of the transversalis muscle (fascia lumborum) is exposed, and in the posterior part the anterior edge of the quadratus lumborum. As a rule the latter muscle does not require division.

After the aponeurosis of the transversalis has been divided upon a director, even in the most emaciated patients, a quantity of loose fat comes into view in which the kidney is embedded. On tearing this gently away in the position of the colon, the transversalis fascia is exposed. This structure should be cautiously torn through by means of two pairs of forceps. Its strength varies very much, and it is apt to be mistaken for the peritoneum. The bleeding, so far, is as a rule very trifling, and any hæmorrhage may be checked by torsion. If the region of the quadratus be encroached upon by the knife, a lumbar artery may be divided. The finger should now be introduced into the wound, and the position of the kidney, which lies behind the bowel, made out. The finger should then be passed into the angle between the psoas and quadratus lumborum muscles. The non-peritoneal surface of the colon looks into this angle, and if, while the finger be held in this position the patient be rolled a little over to the left side, the gut which comes into contact with the digit must be the descending colon. The bowel should now be hooked forward into the wound, and an attempt made to expose that surface which faces the angle just mentioned. When the bowel is much distended, it will protrude into the wound as soon as the tranversalis aponeurosis is divided, and the procedure just named is not necessary. Some surgeons distend the colon by air, or by injections of fluid, before the operation is commenced; but the measure is seldom necessary. 'A large curved needle, carrying stout silk, is then to be passed through the skin to one side of the ink mark, across the bowel, and through the skin at a corresponding point on the other side of the mark, and the entire proceeding is to be repeated at the other end of the incision. The colon is thus fixed before being opened, and is held in place by the threads, which are grasped by assistants. It only remains now to open the intestine, and this is best done midway between the two threads by a small longitudinal incision, which may be cautiously enlarged so as to be about one and a half inch in length. The finger passed into the bowel can now draw out each loop of thread by which it is transfixed, and these being divided will give four threads already passed through skin and intestine, and only requiring to be tied. The anterior and posterior extremities of the wound should afterwards be drawn together with two stitches, and the operation is completed' (Heath).

As regards after-treatment, the skin about the wound should be kept carefully oiled, and the parts protected by a large pad of 'tenax.' The stitches may be removed at the end of six or seven days, or may be allowed to cut their own way out. When the parts are consolidated, it is well to gently introduce a tube into the bowel below the fistula, and wash out the fæcal matter contained therein, since the retention of such matter often gives rise to much inconvenience. When the case is not urgent, it is well to perform the operation by two stages, the first of which may be done antiseptically. In the first stage the gut is exposed and secured to the wound by sutures which only penetrate the muscular coat. The bowel is not opened. At the end of a few days, when the gut has acquired firm adhesions to the margins of the wound, the antiseptic dressings may be left off, and the artificial anus established. In this way the extensive suppuration that sometimes follows the escape of fæces into the subserous or inter-muscular connective tissues, may be avoided; the evils of an accidental opening of the peritoneal cavity are reduced to a minimum, and the healing of the wound is greatly hastened. To avoid the trouble consequent upon the accumulation of fæces in the bowel below the artificial anus, Madelung proposes to empty this segment of the gut of its contents, and then entirely close the end of the intestine below the abnormal opening.

In *Inguinal Colotomy* the abdomen is opened by an incision about three inches in length, which is made parallel to and just above Poupart's ligament; the inner end of the incision being just external to the deep epigastric artery. The bowel, having been exposed, is secured to the margins of the wound by the same means as in lumbar colotomy. The great disadvantages of this operation are the less convenient position of the artificial anus, and the fact that it involves an opening into the abdominal cavity. Erckelen's statistics, which deal with 262 examples of colotomy, show that the mortality after all forms of colotomy, taken together, is about 54·2 per cent.; the mortality after Amussat's operation is 38·4 per cent.; and after Littre's, 46·4 per cent.

FREDERICK TREVES.

COLOUR-BLINDNESS. — Colour-blindness may be either congenital or acquired. The congenitally colour-blind, though possessing perfect sight for form, are unable to appreciate some differences in colour which are obvious to others. The three colours principally concerned in well-marked congenital colour-defects are red, green, and violet. Light of these three colours when combined by mirrors, by two overlapping spectra, or on a rotating disc will appear to a normal eye white or grey. These three colours are, moreover, peculiar, in that they are the only ones which cannot be produced by the mixture of other spectral colours. They are therefore called fundamental colours. While normal vision appreciates these three fundamental colours in the spectrum, and, in addition, certain others, yellow and blue, between them (omitting the orange), most congenitally colour-blind persons appreciate only *two* fundamental colours. Their vision is consequently said to be dichromic.

But there are very rare cases in which one colour only is appreciated in the spectrum, whose various parts consequently appear different only in their degrees of brightness. Achromatopsia is the term applied to such a defect. Those above referred to as possessing a dichromic system are said to suffer from *partial* achromatopsia.

Total colour-blindness (achromatopsia) is very rare, occurring perhaps once among ten thousand men. We are unable to say exactly how things appear to the totally colour-blind, whether, for example, in shades of grey, from white to black, like a photograph to us, or in various shades of one of the fundamental colours, such as, for example, violet. A total colour-blind would pick out coloured wools indiscriminately, except for the different amounts of light which different colours reflect. The defect may be completely developed, or a feeble perception of all three fundamental colours may still exist. It is very questionable whether total achromatopsia ever occurs, unless in association with other ocular defect. It is usually observed that, in association with some defect for form, the disc is white, or there is nystagmus or photophobia. Partial colour-blindness (partial achromatopsia) occurs more commonly. It does not appear to be necessarily associated with anything pathological, since the sight for form amounts to about the average.

One of the fundamental colours is wanting entirely or in part to the partially colour-blind. Their colour system is therefore dichromic. Occasionally violet is the defective colour. In such cases the sufferer would appreciate only two out of the three fundamental colours that are normally visible in the spectrum. Whereas we see *on the left* red, followed by orange, yellow, green, blue, and violet, he would see only one *to the right*, representing violet, blue, and green, and one only *to the left*, representing the red and orange, his two colours being separated by a grey band which occupies the position of the yellow. Consequently he will mistake—unless, indeed, he can guess at them by the relative degrees of brightness with which they are associated in his mind—green, blue, and violet for each other, but he will sharply distinguish them from red and orange. Violet would be a darker shade to him than to us, so that dark violet would be undistinguishable by him from black, and the extreme right hand of the spectrum would be shortened. Such cases are extremely rare, perhaps 1 in 10,000 men, and on this account, and from the nature of the colour concerned, are of less practical importance than those next to be described. It is said that the drug santonine will produce temporary violet-blindness.

The great majority of partial colour-blinds are defective to red and green, and consequently their defect has received the name of red-green blindness. The spectrum is divided to them by a narrow grey band where the green and blue shade into each other. All to the *left*—viz., the red, yellow, and green—appears of the same colour, though of vastly different shade in its different parts; and all to the *right*—viz. blue and violet—of another strongly contrasted colour. The yellow is far brighter to them, as to us, than the neighbouring red and green. Consequently they are not liable to confuse yellow with either red or green. But the two latter, being far nearer in shade, are liable to be mistaken for each other.

Red-green-blindness is undoubtedly divisible into two varieties, of which the one is called *red-blindness*, and the other *green-blindness*. It is difficult to say how these colours really appear to the red- or green-blind; but, judging from rare cases of colour-blindness in one eye only and from other evidence, it is not unlikely that to the *green-blind* all to the left of the blue and violet (which appear as blue) is represented *at its brightest part* by yellow, just as to us, shading off on either side into a much duller reddish hue, which is slightly darker to the *right*—that is to say, in the green than to the left, i.e. in the red. Their two fundamental colours, speaking generally, will thus be blue and some variety of red, and the two will be separated by a narrow belt of neutral or grey colour. Though they will never match yellow, whether in the spectrum or in pigments, with green or red, they will be liable to confuse the two latter colours. But to match a vivid scarlet they will pick out a green lightened by some slight admixture of yellow, and they will see bluish-green and grey alike.

Similarly, to the *red-blind* all to the *left* of the spectrum is represented by yellow, shading off into a greenish colour, which is much darker in the red than in the green region of the spectrum. Indeed, the extreme left-hand end of the spectrum cannot be distinguished from black by the red-blind. It is as if the brightness of the left-hand part of the spectrum were shifted rather towards the right, and with it the dividing band between the blue and their other colour, whereas in green-blindness it is moved, though to a much less extent, the reverse way. Consequently the red-blind will match a scarlet with a dark green and with a dark brown.

It is obvious, from what has been said, that the detection of physiological colour-blindness is not so very simple a matter as it would at first sight appear. Even a total colour-blind—i.e. one to whom differently coloured objects appear simply as various shades of one colour, as does a photograph to us—will not match yellow with an average blue or even with a red, since the three appear of quite different shades, from the brightest, the yellow, to the darkest, the blue. In the same way a red-blind would not match an average red with an average green, the first appearing to him much darker than the other. But if coloured surfaces or coloured lights of exactly corresponding shades to him were presented, he would be totally unable to distinguish them. All tests of colour-vision are on this principle. The most scientific is doubtless by the use of the double spectroscope. But others, which are more easily and conveniently applied, suffice for all practical purposes.

The coloured wools which pass under Holmgren's name show a large number of shades of differently coloured woollen skeins.

The person to be tested is given a skein of a pure pale green colour; *pale* because many will fail at this who would be successful with a stronger colour, and *green* because it is a defective colour, not only to the red- and green-blind, but also to the violet-blind. He is asked to pick out all the skeins which seem to him like the sample given or, perhaps better, all which contain some of that colour, little or much. It is important that the colour should not be named, otherwise an ignorance of the names of colours may possibly be mistaken for colour-blindness. If his colour-vision be defective, he will pick out other colours as well as various shades of green; for example, greys, browns, pinks, or blues and violets. This alone is sufficient to demonstrate the fact of colour-blindness. If we want to know something as to its degree and kind, we may go further. If he has selected greys, browns, or pinks to match with the green, he is probably red- or green-blind. If then, a pale rose-coloured skein—i.e. a mixture of blue and red—be given him, he will, if red-blind, pick out dark blue and violet to match with it, the red being to him little more than a darkening shade. If, on the other hand, he be green-blind, the rose will be to him more of a neutral tint, and he will match it with grey and with bluish-green. If he is offered a scarlet he will match it, if red-blind, with a green or brown which appears to a normal eye much darker; whereas, if he be green-blind he will match it with a light brown or with a green lightened with some slight admixture of yellow. If his failures do not extend beyond the first test, excluding violet-blindness, he is called an incomplete partial colour-blind.

The coloured squares of 'Ole Bull' are on the same principle, but here red, green, blue, yellow, and grey squares, 10mm. in diameter, are arranged in rows from the faintest—i.e. the first—down to the most intense, the tenth row. The colours of each row, from the strongest upwards, are successively diluted by admixture with grey, so that those of each row, while being all of exactly the same shade, are of less intense colour than the row below them. Consequently the colour-blind will readily mistake the colours of the various rows; and the amount of his defect will be judged by the faintest row he is able to indicate correctly. The colours of the first row are recognisable by the normal eye at 1 metre distance in good light. The patient is shown the grey square, and asked to name the other colours of the first row. If he fail at this, squares in other rows below are successively indicated. If, for example, he can do only the one marked No. 6, his colour-vision will amount to one-sixth only. The test is therefore quantitative, and in this respect it excels that by coloured wools. It is also, as will be seen presently, better adapted for most pathological colour-defects.

What is called the shadow test is interesting. If an object be illuminated by two lights, one coloured and the other an ordinary light or colourless, the shadow cast on the coloured ground by any object, such as a pencil, takes by contrast the complementary colour. Thus, if the light be red, the pencil will throw one shadow from the ordinary light, which will appear red, and one from the red light, which will appear green. But to the red- and green-blind the complementary colour is not recognisable.

The pseudo-isochromatic tables of Stilling are on the same principle. Letters of one colour are printed on a background liable to be confused with it. But, in consequence of the great difficulties in making lithographic colours present a similar surface as to smoothness and brightness, as well as exactly the same shade, the test is of little practical use.

Donders has arranged certain quantitative tests. They consist of small circular coloured spots of different sizes attached to a surface of black velvet. The normal distance having been previously carefully determined by experiment, the distance at which the candidate can recognise them is noted. A spot of red or green should be recognised in good daylight at 5 metres (about 16 feet). Similarly, discs of coloured glass are presented in front of a light successively, by aid of a revolving disc. Since ordinary coloured paper or glass rarely approaches a pure colour, the material for this test requires great care in its selection. These tests of

Donders are, on the whole, best adapted for determining the fitness of railway-drivers or look-out men at sea for their work.

Colour-blindness exists to a greater or less extent in about 4 per cent. of men. In women it is at least ten times as infrequent, and even correspondingly less in degree. It is slightly less common in the upper—that is to say, the more educated—classes of life, than among ordinary people. Education will, however, do nothing for its removal, and, so far as we know, nothing for its prevention in the individual. We can only speculate why it is less common in women. It is very liable to be transmitted by inheritance, perhaps as much through the mother, though she so rarely manifests it herself, as through the father. After total achromatopsia violet-blindness is the most rare, perhaps amounting to $\frac{1}{2}$ per cent. in men. Consequently defects to red and green are far more important, not only on account of their greater frequency (about 3·5 per cent.), but because lights of these colours are universally used as signals. Indeed, any other colours would be quite unsuitable. Yellow would be liable to be mistaken for an ordinary light, and blue, being much duller than any ordinary yellow, would be visible at a much shorter distance, and so could not be opposed to it. The importance of colour-blindness in relation to coloured signals reaches its maximum in the case of the red-blind, to whom a red light appears far darker than the green. Indeed, it is so much darker to him than to the normal eye that he cannot recognise it at all, even as a light, till within a much shorter distance than normal. If the two were contrasted at a short distance only, he would consequently see both, and distinguish them by their relative brightness. But if either were exhibited at a distance, and under conditions of brightness previously unknown to him, as at sea, he would be utterly unable to recognise its colour. The peripheral parts of the retina are normally less sensitive to certain colours than to others. If red and green spots be presented under ordinary daylight at the periphery of the visual field, their colour cannot be distinguished, whereas blue and even yellow can be perfectly recognised.

Acquired colour-defects are also important, both in their relation to coloured signals and as symptoms of certain diseases, such being atrophy of the optic nerve, both primary, as from tobacco and alcohol poisoning, and secondary to more general conditions, such as locomotor ataxia and disseminated sclerosis. Green and red are the first colours to go, the former being usually called white and the latter brown; or the two colours are undistinguishable. In tobacco and alcohol amblyopia the loss is at first limited to the immediate neighbourhood of the point of fixation (central colour scotoma), so that the patient, though he can recognise small spots of these colours when held somewhat laterally in any direction from his point of central vision, fails to recognise them when moved to the centre. This failure may be partial, in which case the colours are seen less vividly, red as brown, for example (relative scotoma), or total, in which case he sees the spot of no *colour* at all (absolute scotoma). *See* AMBLYOPIA.

But in other diseases, such as the atrophy of locomotor ataxia and disseminated sclerosis above mentioned, and the atrophy that sometimes follows blows on the head or typhoid fever, appreciation of red and green becomes entirely lost, or all perception of colour may be permanently gone. A complete loss of all colour-vision may occur temporarily in hysteria.

It is in the highest degree questionable whether an acquired defect for red and green ever exists without some loss of central acuity for form, but it is certain that colour may fade in undue proportion to form, especially in tobacco amblyopia. Consequently a patient suffering from this affection may go about and carry on all his other duties perfectly well, and still be totally incapable of distinguishing a red from a green signal right before him. It is probable that acquired colour-blindness is even more important in respect to signals than the congenital form, since the sufferer has had, in the former case, little time or, indeed, opportunity to recognise his defect, occurring almost invariably, as it does, between forty and sixty years of age; and he being able, in early cases of tobacco and alcohol poisoning, still to recognise colours in the circumstances under which they are usually presented in every-day life.

From what has been said it will be evident that certain acquired defects of colour will escape detection by Holmgren's coloured wools. It needs the use of the coloured discs of Donders or of 'Ole Bull,' or, perhaps better than either, of red and green squares, 10mm. and less in diameter, mounted on a black card, which may be conveniently supported on a handle. The examination may be made, either by the patient fixing the corresponding eye of the observer at a distance of a foot, or by the use of the perimeter.

W. A. BRAILEY.

COMA. *See* HEAD-INJURIES.

COMEDO.—*Definition.*—A collection of sebum distending beyond its normal limits a sebaceous gland, the external aperture of which remains patent.

Symptoms.–Comedones form at or about puberty, when the hair-follicles of certain regions are in active development. The sebaceous glands enlarge and secrete more sebum than can be expelled from the mouth of the follicle.

People with coarse skin and feeble circulation and a scanty growth of hair are most prone to them. The forehead, nose, cheeks, chin, inside the ears, the chest, back, and neck, are the parts commonly affected, and they rarely occur elsewhere. Sometimes they are congenital. They appear as yellow or black specks on the skin, slightly raised, which, when squeezed, eject a long worm-shaped mass, consisting of sebaceous matter, and in its substance there is occasionally found a minute grub. *See* Acarus Folliculorum. The elongated shape of the mass is the result of its having been squeezed through the narrow neck of the follicle. Some think the black on the surface is due to dirt solely, others trace it to pigment. When, as is often the case, the comedones become inflamed, acne vulgaris is produced.

Treatment.—Where there is a tendency to the development of comedones it is well to wash several times daily with hot soap and water, using at the same time much friction with a rough towel. All the spots should be squeezed and the matter forcibly removed, and, to prevent the sacs refilling, it is necessary to insert a needle and scarify the lining membrane, which will have the effect of completely obliterating them. Lotions or liniments containing soap and spirit are most useful, to dissolve the sebaceous matter and to stimulate the capillary circulation. The following is a good formula: ℞ Sapo mollis, ℥j.; Eau de Cologne, f℥jss.; Sp. vini rect. f℥ij.; Aq. sambuci ad f℥vj.; fiat lotio. To be used twice a week at bed-time. Mildly stimulating ointments containing small quantities of either sulphur or tar are also of value. Internal remedies should be employed if there is any irregularity of the digestive organs or other functional disturbance.

Malcolm Morris.

COMPRESS. *See* Pressure.

COMPRESSION. *See* Pressure.

COMPRESSION OF THE BRAIN. *See* Brain, Compression of the.

CONCUSSION OF THE BRAIN. *See* Brain, Concussion of the.

CONCUSSION OF THE SPINAL CORD. *See* Back and Spine, Injuries of the.

CONDYLOMA. *See* Mucous Patch; Syphilis; Warts.

CONGENITAL DEFORMITIES. *See* Atresia Ani; Club-Foot; Congenital Dislocations; Ectopia Vesicæ; Hare-Lip, &c.

CONGENITAL DISLOCATIONS.—Congenital dislocations are most frequently found at the *Hip-joint.* Cases, however, have been described of similar luxation of the *Humerus*, of the *Patella*, of the *Lower Jaw*, of the *Elbow* (probably only of the radius), of the *Knee*, and of the *Wrist.*

In the last four positions the dislocation is rare. It is usually partial, complete dislocation occurring only with other extreme deformities, the subjects of them being little better than monstrosities. These rare forms may be dismissed in a few words.

A case of congenital dislocation of the *Lower Jaw* on the right side has been described by R. W. Smith of Dublin. The right side of the jaw and right zygoma were smaller than on the left side, the condyle was undeveloped and destitute of cartilage, the coronoid process was small and thin, and the sigmoid notch was barely existent. There were neither glenoid cavity, nor interarticular cartilage, nor capsular ligament. The right superior maxilla and malar bones, and the right side of the sphenoid, were also much smaller than on the left side. In these cases the jaw is abnormally movable, and not fixed as in ordinary dislocation.

Good specimens of congenital dislocation of the *Head of the Radius* backwards exist in the museums of the Royal College of Surgeons of Dublin and of Guy's Hospital. The former was fully described by the late R. Adams. The outer condyle exists, but in front of it there is no rounded head for the radius, nor any trace of the usual convex articular surface ever having existed. The coronoid process and great sigmoid cavity of the ulna are unusually large transversely, and stretch almost the whole way across the lower articular extremity of the humerus, which is entirely formed into one single trochlea wider than natural. The head of the radius, which seems never to have been adequately developed, is situated behind the plane of the outer condyle of the humerus. The tubercle of the radius, directed somewhat backwards, is twice its natural length, and instead of reaching merely to the level of the lesser sigmoid cavity of the ulna, stretches so high up the ulna as to reach nearly to the level of the summit of the olecranon process, while the carpal extremities of the radius and ulna are in their natural state, on an even line with each other. The arm in these cases is in a state of pronation and semiflexion, and there is little or no power of supination. There is a case also recorded by R. W. Smith of dislocation of the radius backwards, with deficiency of the condyle of the humerus, in which there was also on the same side an outward dislocation of the patella, with deficiency of the external condyle of the femur.

Congenital dislocations of the *Knee* are very rare, but a few cases have been described. They generally take the form of partial dislocation of the tibia forwards in one or both limbs.

Very few cases of congenital luxation of the *Wrist*, not in monstrosities, are recorded. There is a case fully described by R. W. Smith, of a female lunatic, æt. thirty-six, who had from birth a luxation of the right carpus forwards and of the left carpus backwards, with the upper end of the left radius small and atrophied. The bones of the forearm in both limbs were only half the ordinary length, and the bones of the carpus were atrophied. A case described by Cruveilhier as traumatic, Smith alleges to have been an example of congenital luxation. There is also a specimen of congenital dislocation of the wrist in the Dupuytren Museum.

Congenital dislocation of the *Patella* is not very uncommon. In nearly all the cases recorded the luxation was in the outward direction, the number of cases in which the displacement was single and symmetrical being about equal. In many of the instances deficiency of the external condyle of the femur fully accounted for the malposition of the patella. In all there was considerable muscular wasting and relaxation of the structures of the joint. In many of the cases the hereditary nature of the condition was remarked.

Congenital dislocation of the *Head of the Humerus*, though less rare than any of the above forms of luxation, does not occur, or at all events is not recognised, so frequently as the similar condition at the hip-joint. There are two varieties, the sub-coracoid and the sub-acromial. Guérin gives two examples of the former, and one of the latter. Both varieties have been fully described by R. W. Smith, who gives four cases of the former, and one of the latter. The leading characteristics of all are wasting of the muscles of the shoulder and arm, an abnormal prominence of the acromion process, and a marked limitation of the movements of the arm. Of the sub-coracoid dislocations, three occurred in males:—1. Æt. 20, the luxation being on the left side. This man had also left talipes equinus. 2. Also a male, æt. 20, the dislocation on the left side. 3. A lunatic woman, æt. 29, with congenital luxation on both sides, the deformity being more marked on the left side. 4. A boy, æt. 9, with luxation on the right side. The only case of congenital sub-acromial or sub-spinous dislocation recorded by Smith was found in a woman æt. 42. She had been a lunatic fifteen years, and was subject to severe epileptic fits, in one of which she died. The brain presented the appearances common in idiots. Each humerus was dislocated upon the dorsum of the scapula, the coracoid process formed a remarkable projection on each side, and the acromion process was unusually prominent, but the glenoid cavity could not be felt beneath it. In fact, an examination showed that there was no trace of a glenoid cavity in the usual position, but there was a well-formed socket, surrounded by a glenoid ligament, upon the outer surface of the neck of the scapula, broader above than below, and reaching upwards close to the under surface of the acromion. The tendon of the biceps, perfect throughout, adhered to the upper and inner part of the circumference. The head of the humerus was oval in form, and atrophied, and occupied the cavity immediately beneath and behind the summit of the acromion.

The third case of sub-coracoid dislocation mentioned above died of meningitis; and examination showed that there was, similarly, no vestige of a glenoid cavity in the normal position; but directly beneath the under surface of the coracoid process, and formed partly upon the costal surface of the scapula and partly upon its axillary margin, there was a well-formed socket about an inch and a-half in diameter. The head of the humerus was close to the under surface of the coracoid process, and only separated from it by the capsule, there being no interval, as there is in the natural condition of the bone, between the upper margin of the abnormal socket and the process just named. Around this socket the glenoid ligament, perfect and well-formed, was continued from the undeveloped glenoid cavity, from the apex of which sprung the tendon of the biceps, in every respect natural. The capsular ligament was perfect throughout. Here, also, the head of the humerus was oval from deficiency of the posterior part of the bone, and there existed, between the greater tubercle and the margin of the head of the bone, where the investing cartilage terminated, a broad, shallow groove corresponding to the elevation which distinguished the normal from the abnormal portion of the glenoid cavity. The shaft of the humerus was small, and seemingly atrophied. Upon the right side, where the deformity was less marked, the deficiency of the glenoid cavity was confined to its inner border, which, to the extent of an inch from above downwards, was entirely wanting, so that the head of the humerus had passed inwards, though not to such an extent as in the opposite joint. The internal boundary of the socket was formed by a ridge of bone, which passed downwards from the under surface of the coracoid process. The oval form of the head of the humerus, and the deficiency of its posterior part, were more striking than on the left side.

It is probable that congenital luxations of the shoulder are less rare than is supposed. They are almost certain to be overlooked during the early years of the patient, and until the bones and muscles have become developed; and then, except in the atrophic cases, so much freedom of motion may have been acquired that this peculiarity is attributed to awkwardness, and the anatomical condition is rarely critically and accurately examined. In those cases where atrophy of the muscles is complete, there ought to be no difficulty in diagnosing this condition from a local paralysis.

Congenital dislocations of the *Head of the Femur* are not rare, although, as Dupuytren pointed out, they frequently escape notice in the infant. Carnochan expresses the opinion that the congenital form of luxation of the head of the femur is of as frequent occurrence as the corresponding dislocation caused by external violence during extra-uterine life.

Dislocation occurs in three directions. The most usual form is luxation upwards and outwards upon the dorsum of the ilium; the second form, directly upwards, is rare; as is also the third form, upwards and forwards, which is usually associated with other very considerable deformities. The great majority of the cases are of the first variety, but the first and second varieties may be taken together, as they are very similar. They occur most frequently on both sides and in girls. Dupuytren, who saw 26 cases, found 22 in females and only 4 in males. In all but four of the cases the dislocation was double. Of Brodhurst's 36 cases, 28 were females and 8 were boys; 29 were double luxations, and 7 were single. Of Cruveilhier's 7 cases, 5 were double and 2 single. In 7 cases seen by the writer, 6 were double and 1 single, and all were in girls. Four of these symmetrical cases were shown together, on November 17, 1883, at a meeting of the Royal Medical and Chirurgical Society.

The signs of this dislocation are not distinctly marked at birth, and, unless they are sought for, are easily overlooked. When the child has acquired the power of walking they become unmistakable. They are best seen in the erect position, for when the patient is lying horizontally on the back many of the peculiar symptoms disappear. The main characteristics of symmetrical congenital dislocation of the hip-joint are —an abnormal prominence of the great trochanters, which are situated higher and generally more backward than usual. There is a wide, flattened appearance of the nates; a marked compensatory lordosis, and accompanying prominence of the belly; a more or less wasted condition of the muscles of the hip and thigh; and a peculiar, swaying, waddling gait, the width of the hips being increased, the knees more nearly approximated, and the usual movements of the hip-joints being somewhat limited and awkward; the legs, also, are small, and the feet weak, with a tendency to *flat-foot.* When the dislocation is on one side only, the gait is, of course, different, and less characteristic, the shortening of one limb causing more marked lameness.

The increased mobility of the head of the dislocated thigh-bone is very remarkable, but is well accounted for by the relaxed condition of the ligaments of the joint. The anatomical conformation of the bones of the part varies somewhat according to the age at which the examination is made. Before the age of attempting to walk, the head of the femur will not be found to have travelled far, but only to occupy the posterior and superior border of the shallow acetabulum where its fibrous margin is deficient. But a few years later the somewhat flattened head of the femur will be found upon the dorsum of the ilium in a direction backwards and upwards, the acetabulum being shallow, and sometimes of a more or less triangular shape, and filled with adipose tissue. The ligamentum teres is elongated and attenuated, and the capsular ligament presents an hour-glass appearance, being large at its attachment to the margin of the acetabulum and to the head of the femur, but very narrow at its middle, where it surrounds only the ligamentum teres and is greatly stretched. In a few cases that have been described, the round ligament has been said to have been absent, and it is probable that in these cases it has gradually become so attenuated as to have given way.

In the cases where the dislocation is more directly upwards, the gait is slightly less characteristic, and the lordosis and prominence of the abdomen are less marked, but the anatomical condition is very similar.

There is no agreement amongst the writers on this form of dislocation as to its pathology. Amongst the different causes and explanations which have been given of the occurrence of congenital dislocations, the following may be enumerated :—1. External violence affecting the fœtus in utero ; 2. The position of the fœtus in utero, and violence during parturition (Cruveilhier) ; 3. Morbus coxæ in utero ; 4. A distension of the capsular ligament, and a consequent disproportion between the head of the bone and its socket (Stromeyer) ; 5. A primitive alteration in the germ, or an aberration of the formative power (Dupuytren) ; 6. A primitive alteration in the nervous centres ; 7. An arrest of development in the acetabulum ; 8. An arrest of development of the head of the femur ; 9. An active or primary retraction of the muscles (Guérin) ; and 10. Paresis of the muscles.

The first cause mentioned may be dismissed as unsupported by evidence. In support of the second it has been asserted that in the majority of these cases either the breech has presented at the time of birth, or they have been first children, or born after difficult or tedious labours. It is difficult to ascertain if there is really any foundation for these assertions. The birth-presentation is not recorded in the majority of the cases which have been collected. In the writer's seven cases, only one was a breech presentation ; one other was a first child ; but with the rest the labours were easy and not prolonged. Adams, too, reported that in the majority of his cases, 50 in number, the labours were free from difficulty. If luxations did occur from this cause, it would be more accurate to describe them as traumatic dislocations occurring at birth than as strictly congenital luxations. It may be further added, that it has been sought to explain the more frequent occurrence of this dislocation in females, by pointing to the greater width of the female pelvis, as being more likely to be the subject of compression and consequent displacement of the femora during birth by the breech. As a physiological fact, however, the pelvis of the female at birth is smaller than that of the male, and the supposition is incorrect. Nos. 3 and 4 have been given as causes in a few cases, on good authority. The great majority of the cases, however, are due to one or more of the remaining causes, Nos. 5 to 10, which may all be classed under the one term of *arrest of development* or *faults of formation.* This arrest of development, whilst it is more marked in the acetabulum than in the other parts entering into the formation of the joint, is, in all probability, primarily due to some deficiency or derangement of the nervous centres. And this is probably the case in all the forms of congenital dislocation, and is especially evident in the more unusual forms which have been shown above to be generally associated with idiocy or lunacy. In some of these cases the malformation has undoubtedly been hereditary.

The absence of the ligamentum teres in a few of the hip cases has led to the suggestion that such absence may possibly be a reversion to the structures of the hip-joint in fishes and reptiles, where it is absent, as it is also in the kangaroo, the elephant, the rhinoceros, the hippopotamus, and in the phocidæ, sloths, and orangs.

During the growth and development of the subjects of these dislocations, considerable changes take place in the bony framework of the pelvis and the surrounding parts. The innominate bones are found to be smaller and more vertical in position. According to Carnochan 'the anterior inferior spinous processes of the ilia are found to be more prominent, and the depressions existing below them are seen to be deeply grooved by the continued traction of the tendons which played in them during life.' The greater the amount of displacement of the head of the femur, the more the shape of the pelvis is altered ; but in all the cases the antero-posterior diameter is diminished, whilst the transverse diameter is proportionately increased. The sacrum is usually somewhat stunted in growth. When the dislocation is on one side only, the pelvis becomes gradually somewhat twisted, and the ilium of the affected side occupies a slightly higher level than on the sound side, the symphysis pubis being drawn a little towards the same side. Wherever congenital dislocation exists, the bones are thinner than usual and somewhat atrophied. Any imperfect acetabulum that may have existed becomes filled up with adipose tissue and the margin, if any, becomes flattened

In many cases a shallow depression is formed in the new position of the head of the femur, and this depression usually becomes sooner or later surrounded by a deposit of new bone. At the same time the head of the femur may become smaller and more rounded.

Treatment.—Much difference of opinion has existed as to the possibility of surgically correcting the displacement in these cases. Dupuytren denied it. But since his day several cases of successful reduction have been reported, and it is probable that there are some cases in which an attempt at rectification should be made. There are two conditions of success:—The luxation must be recognised in early life, and before the relative condition of the parts has been altered by the natural adjustment which gradually takes place; and, secondly, the departure from the normal conformation of the articular surfaces must be moderate and much less than exists in many of the cases. If nothing is done, the tendency is to increased deformity, the amount of displacement being augmented by the weight of the body in the erect position. Where such increased displacement has taken place, and where the changes in the bones above described have been accomplished, no readjustment is possible. But in an earlier stage, and where the displacement is not excessive, some attempt at reduction should be made. To effect this, when ordinary manipulation is insufficient, Guérin has suggested the subcutaneous division of tendons which seem to maintain the deformity, and also some subcutaneous scarifications in the vicinity of the acetabulum, in order to promote the deposit of organising material. Cases of success at twelve and fifteen years of age have been recorded; but it is only in early years that we may count upon success, and then only in the less marked cases. Apparatus is required to maintain the bones in proper position. The horizontal position of the patient must be maintained, and after the first few weeks passive motion must be daily used. A few months later an apparatus is necessary, to enable the patient to move and exercise the limbs whilst still remaining in the horizontal position, the joint being, of course, unable to bear the weight of the body until the parts have had time to be consolidated in their new position. This motion and exercise must be persevered in for many months before permitting exercise in the erect position, the head of the femur being throughout retained in position by a firmly and properly adjusted bandage. The general treatment of the patient must not be neglected. A webbing support and strap will be required as a permanent means of support, and this will be found of some service in the great majority of cases in which no other treatment is advisable.

George Cowell.

CONGENITAL FRACTURES. *See* Intra-uterine Fractures.

CONGENITAL HERNIA. *See* Hernia, Inguinal.

CONGENITAL SYPHILIS. — The terms 'congenital,' 'transmitted,' and 'hereditary' may, so far as syphilis is concerned, be considered synonymous. They all stand in contradistinction with 'acquired,' and imply that the disease was obtained from a parent before birth, and not from post-natal infection. In all cases of acquired syphilis, with the exception perhaps of a woman pregnant with a tainted fœtus, a primary sore, or chancre, is of necessity the first stage of the disease. In inheritance no such sore occurs, but the virus passes directly from the fluids of the parent into those of the child. The term 'congenital' must not be held to imply that the inheritance is obvious at the time of birth, for it may easily be the fact that no signs of it become apparent until long after. Not the less is it true that the taint—or rather the living virus—was existent in the child at birth.

There may be some variety as to the precise details of inheritance. It may be that it is from the father alone, or from the mother alone, the poison being in each instance present in the parent at the time of conception. To these modes we may give the name 'conception inheritance,' qualified as 'paternal' or 'maternal,' or 'sperm and germ inheritance' respectively. This is the only kind of direct inheritance which, so far as the father is concerned, is possible. The mother may, however, be the means of communicating the disease to her offspring in another manner. It may have been the fact that at the date of impregnation she was perfectly free, and that she acquired the disease at some period of her pregnancy. In this case the fœtus will receive the poison, not at the very starting-point of life, but after a period, of variable length, of healthy intra-uterine life. Facts in abundance prove that at whatever period of pregnancy a woman acquires syphilis, if only time be allowed for her development of the disease, there is great probability that it will pass to the fœtus also. Nor does this happen in the case of syphilis only. If a pregnant woman suffers from smallpox, her fœtus will also be affected, and very probably it would prove to be the same with the other exanthemata if their stages were sufficiently prolonged.

It may be convenient here to ask the question whether the transmission of syphilis in this way from the mother's blood to that of her child, through the placental circulation, produces results differing from those which follow sperm—or germ—inheritance. The question may be answered, temporarily at any rate, with a denial, and the *onus probandi* may be suitably thrown on those who assert it. The writer attended a lady in the seventh month of her pregnancy for primary syphilis. He saw her indurated chancre and also her rash. Her husband was also under his care for the disease. The child was born looking healthy, but it began, as usual, to suffer from snuffles at a month old, and it went through a severe infantile illness with all the usual symptoms. It recovered under mercurial treatment, but subsequently showed characteristic teeth and physiognomy, and had a severe attack of keratitis with periostitis of the tibia and effusion into knee-joints. This child was under observation for ten years, and there was nothing whatever to distinguish its symptoms from those which we see so frequently as the result of sperm—or germ—inheritance. Other cases of a similar kind might be adduced, and they justify us in holding for the present that the results of pregnancy-infection and conception-infection may be, and probably are usually, closely similar.

We must next ask whether sperm inheritance differs in its results from germ inheritance, and whether when the child receives a taint from both parents it suffers more severely or in any way differently from when it receives it from only one. We enter here upon a most difficult enquiry, and our knowledge of the laws of inheritance are not sufficiently advanced to permit of categorical answers being given. Nor, indeed, have our facts, as to the inheritance of syphilis, been as yet collected and compared with sufficient care. It may prove that future investigations will succeed in establishing more detailed and definite laws, as explanatory of the variety of clinical phenomena which we witness. On the other hand, it may perhaps come about that we shall see that we have already gone farther in this direction than either our present or our future knowledge will warrant. We are met at the very threshold of our enquiry by the fact, that we do not yet know the limits of possible variability in the phenomena of syphilis, independently of any appreciable change in the conditions of its origin. Thus we are constantly in danger of assuming that differences which we observe in the course and severity of the disease are due to peculiarities in the mode of acquisition, when in reality they were quite possible under modes which were identical. The more we study the subject, the more shall we feel obliged to acknowledge the importance and width of bearing of this fallacy. We must also be exceedingly careful as to giving our confidence to single and isolated narratives, whether they be the results of our own observation or the records of other surgeons. There are in respect to syphilis such endless sources of mistake that, however clear the seeming inference may be, it is never safe to trust it unless it has the support of many independent observations. Acting on this rule as to the reception of evidence, the writer will in what is to follow, trust far more to the general indications of daily experience than to the apparent lessons of individual but isolated cases.

Whilst all admit that a child may inherit syphilis from its mother, there are possibly still some who doubt whether it can inherit from its father independently of the mother. The evidence on this point seems to the writer overwhelming. It is a matter of constant experience that the father of a syphilitic infant is known to have had the disease before marriage, whilst not a symptom has ever been observed in his wife. It is improbable in the highest degree that a large number of married women should acquire syphilis in its primary form, pass through its secondary stages, and yet never know it. Yet this is the supposition which we must adopt, not once or twice, but as an every-day hypothesis, if we reject the belief that a syphilitic father may beget a syphilitic child quite independently of any previous infection of its mother. There are, however, other supporting facts. In these cases it very frequently happens that the taint in the father is wholly latent, and that he has for long appeared to be absolutely well, and that he has no trace whatever of sore on his penis by which a primary infection might be effected. Then, again, not only has the disease wholly escaped the observation of the mother, but she appears, on the most minute examination, to be wholly free from symptoms, and in many instances she remains so in after-life. Such facts are wholly inconsistent with the supposition that she has passed through syphilis in its ordinary stages as an acquired disease.

In nine cases out of ten, acquired syphilis is an affair which its victim cannot either ignore or forget.

It being then taken as established that a child may at the time of conception inherit syphilis from its father alone, from its mother alone, or from both simultaneously, and that it may take it from the mother's blood during pregnancy, we have to ask whether the disease presents any differences under these several conditions. The answer to this has already in part been given, for it has been asserted that what has been termed 'pregnancy inheritance' is just as severe as conception inheritance. Diday has cited a number of facts in proof of this, and all that the writer has observed is in unison with his conclusions. To avoid tediousness, it may perhaps be asserted briefly that there is no reason for believing that the inheritance from the mother (germ-transmission) produces more serious results than sperm-transmission, or that the child who inherits from both parents suffers more severely than he would if one were free. In connection with this assertion it is to be freely admitted that there are certain facts for which as yet we can find no explanation, and which may possibly lead to some modification of this rule. The cases exceptional to rule are here referred to, in which children are born with syphilitic lesions actually present or with traces of intra-uterine disease, and to the fact, apparently established, that the two sexes do not suffer exactly in the same ratio, the examples of infantile iritis, of keratitis in adolescent periods, and of syphilitic deafness being much more common in girls than in boys.

Having just asserted that the several modes of inheritance amount as regards the heir to exactly the same thing, we have next to ask whether the stage which the disease has reached in a parent makes any difference as to that manifested in the offspring. This is best answered by saying broadly that there is no evidence in proof that it does so. Some facts which are unexplained undoubtedly exist, but there is enough of positive evidence in proof that children which present precisely similar phenomena may be born at the most various periods of the parental disease to make us put them for the present aside. Diday and others have collected evidence on this subject. We shall probably be quite safe in making a *tabula rasa* as regards all theories hitherto advanced in explanation of the different degrees of severity which inherited syphilis displays. These differences are probably not greater than those which we observe in the case of the acquired disease. Chancre-syphilis, as is well known, falls with very different severity of incidence on different individuals. The reasons why it does so are inexplicable, just as are those which apply to the parallel phenomena in smallpox and scarlet fever. It will be wise, therefore, to clear away the old hypotheses and begin the investigation of facts anew.

With the hypotheses which we thus put aside it may be well to associate a piece of matter-of-fact observation which is probably a mistake. It is generally said and accepted that the inheritance of syphilis, when continued through a family of children, shows a tendency to fall off, and decreases in severity in each successive child until it comes finally to an end. The writer himself must take some share of responsibility for the perpetuation of this opinion, which he now believes to be an error. It is also strongly stated by Diday. That the eldest child or elder children—those born nearest to the parental acquisition—are the most likely to inherit it, is unquestionable, and so also is the fact that the younger ones often escape. In admitting this, however, we by no means deny that the disease is apt to occur in a modified form in the younger ones. We shall probably be nearer the truth if we assert that the inheritance of a syphilitic taint is often irregular, that frequently, of several children born under apparently similar conditions, one may receive it and another escape; but that, if it be received, it is always one and the same specific malady. Although it may and does develop with very differing degrees of severity, yet the child who inherits it at all inherits its full risks, and is just as liable as another to its severest manifestations. Much evidence might be adduced to show that, when a succession of children suffer, the youngest may suffer as severely as the eldest. It might also easily be proved that under such circumstances the disease may skip one child and appear again in one still younger.

All authorities are agreed that, as a rule, parents who have reached the tertiary stage, although themselves still liable to suffer, do not transmit. Now and then transmission under such circumstances does occur, especially in the case of the mother, but the rule is as here stated. It may be expressed in another manner—namely, to the effect that those who have allowed a long period to elapse—say two or more years—are not, as a rule, capable of transmitting. The body of evidence on this point in the case of fathers is very large indeed. We see every day fathers of families, none of whose children have ever shown a symptom, but who are yet themselves—after, it may be, long periods of latency—destined to suffer from tertiary phenomena. Such facts are far less frequently seen in the case of women; but then we must remember that the proportion of mothers who have in former life suffered from syphilis is far smaller than that of fathers. Making, however, all allowance for this, we may still believe with confidence that a child has much less chance of escape if the mother be diseased than if the disease be confined to the father. In the latter case, sperm-transmission is the only mode of conveyance possible; whilst in the case of the mother, should the poison not be conveyed with the germ at the time of conception, there are yet nine months of risk to be run, during which it may pass from the blood.

The expressions just used will suggest the hypothesis which is perhaps the best for our use in the attempt to unravel the intricate phenomena of syphilis. It is that the transmission of the disease, as well in inheritance as in acquisition, is always effected by the conveyance from person to person, not of a tendency to disease, but of a particular virus. This virus is probably as specific and individual as are the seeds of barley or clover. If it passes into the sperm or germ, then the fœtus is liable to the full development of the disease; and if it chance that none of its elements do pass, then the offspring, although born to a tainted parent, escapes free. This virus is, during the early periods of syphilis, existent in great vigour in the parental fluids, and during these transmission is almost certain. It diminishes in power, or probably in quantity, as time passes on—and hence the greater chance of escape of younger children—until finally it wholly disappears or dies out. Its disappearance is, however, by no means coincident with entire restoration to health of the patient, who, although fortunately impotent to transmit, is, as just stated, still liable to suffer.

Before proceeding to sketch the results to the child of inherited taint, it is necessary to advert to the curious and unexpected fact that a woman who bears a syphilitic fœtus inheriting from its father—although herself remaining free from symptoms—acquires silently a state of constitution which protects her from syphilis in the future. No other interpretation can, the writer thinks, be given to the facts, upon which is based what is known as Colles' law. The child born of such a mother, if suckled by a wet nurse who has recently had syphilis, will not cause any fresh disease, but if by a woman hitherto free from taint, the risk is great that a nipple-chancre will result. Now the mother of the child, although, so far as appearances have gone, free from syphilis, is, as regards fresh contagion from her child, wholly free from risk. She has thus in some way gained the position of one who has suffered from acquired disease. We know nothing as to the relation which such a protected mother would assume towards other children which she might bear. It is obviously possible that if, in a second marriage, she should bear a child to a healthy father, such child might inherit from her, but it is by no means certain. It is also possible that, in continuing to bear children to a first husband, her taint, acquired through the fœtus, may act in reference to later conceptions, and may thus prolong the risk to their family after the father has ceased to transmit.

The evolution of hereditary syphilis.—The usual course, when syphilis is inherited, is for the fœtus to remain quite healthy during its intra-uterine life. At the time of birth it almost invariably has a clear skin, and appears to be in perfect health. At the end of three weeks or a month, symptoms of coryza, as shown by what is named 'snuffles,' usually begin, and are quickly followed by some eruption on the skin, attended by wasting and fretfulness. During the second, third, and fourth months, unless cured by treatment, all the symptoms will be at their height. Excepting in the addition of 'snuffles,' these secondary symptoms are much the same as those observed in the acquired disease. The precise type of the skin-eruption may vary in the same way—may be papular, scaly, pustular, or bullous. Polymorphism is noticed, and most of the other less frequent phenomena of constitutional syphilis in its early stage, such as loss of hair, iritis, condylomata, and rheumatoid pains are apt to occur. All these secondary symptoms are symmetrical in arrangement and transitory in duration, just as they are in the acquired disease. If the child survive, whether treated or not, by the end of a year all the symptoms will probably have disappeared. The influence of mercury as a specific is just as definite as in the acquired disease. All the symptoms, as if under the influence of a spell, vanish when it is used. Certain peculiarities are stamped upon all the symptoms, however, which are probably due to the very tender age of the patient and incomplete development of the tissues. Thus the general health suffers much more than in the acquired form, and death—an event almost unknown in the latter—is a not infrequent consequence. Periostitis of a definite character occurs in connection with the rheumatoid pains, and, in the case of the epiphyses of long bones, may result in abscess, whilst in the case of the skull-bones it often causes simultaneous thinning and deposit of new bone.

In consequence of the fatness of young infants, the eruptions are prone to assume the form of intertrigo; and, owing to the irritation of the buttocks, &c., by urine and fæces, all syphilitic eruptions are very prone to affect those parts severely. The diagnostic recognition of secondary syphilis in infants is usually easy, but in a certain proportion of cases it may call for the utmost care and skill in observation. The character of the eruption, its colour—like the lean of ham—its location and symmetry of arrangement, its coincidence with snuffles, wasting, and withered aspect generally, make up a picture which it is often impossible to mistake. The very widest allowance for variations in severity must, however, be permitted, and common eczema and other infantile eruptions often closely simulate those of syphilis. It is not uncommon for the *rôle* to be exceedingly imperfect; thus there may be snuffles and mucous patches only, the general rash being quite omitted, or there may be no snuffles and the rash may be ill-marked. Instead of the 'old-mannish aspect' which is constantly mentioned, the child may continue throughout in apparently excellent health. Lastly, it is certain that an infant may pass through the secondary stage of inherited syphilis without ever presenting any symptoms which attract the attention of its nurse. Such cases are common, and they have their exact parallels in the case of the acquired disease. Those who have shown no symptoms in infancy may yet suffer in later life. It is clearly to be understood, however, that when this happens to adolescents they suffer from a class of symptoms wholly different from those of infancy. It is not that the secondary stage has been delayed, but simply that it has been passed through without ostensible disturbance. If secondary symptoms of the kind described are to occur at all, they will show themselves in infancy, and in a vast majority of cases within the first three months of life. This is a very important fact. Many syphilitic infants perish during the outbreak of the secondary stage, and were it not for the specific influence of mercury, probably many more would do so.

If, however, the child survive, in the course of from six months to a year the symptoms common to this stage—the rash, snuffles, mucous patches, &c.—will wholly disappear, and there will follow a period of some years during which no active symptoms occur. After this period of latency there will in many cases come a group of very peculiar affections. Amongst these we must mention chiefly inflammations of certain parts of the sense-organs, the eye and ear. The affection of the ear is attended by noises, &c., but usually neither by otorrhœa nor by pain. It affects both ears, and may induce almost total deafness in the course of two months. Many cases in the early stage recover, but if once the deafness is complete it appears to be incurable. This affection rarely occurs before puberty, and may be delayed till the twentieth year. About the same period of life, but with wider limits still, since it may occur yet earlier or much later, there is a remarkable liability to a very peculiar inflammation of the cornea. Interstitial keratitis in a typical form is always a consequence of syphilis, and it is sufficient for the diagnosis. It must, however, be carefully diagnosed. It usually begins by cloudiness of the substance of the cornea, with ciliary congestion and irritability. The clouds increase and coalesce until the whole cornea looks like ground glass. The affection begins in one eye, but, in the course of a few weeks, attacks the other also. It is always, in the end, symmetrical, although in rare cases the interval between the two eyes may extend to several years. When at its height, interstitial keratitis may for a few weeks almost entirely abolish sight; but one of the most remarkable features in its clinical history is its invariable tendency to recovery. In the end the cornea usually clears completely. *See* CORNEA, Inflammation of the.

At the same time as the keratitis, the patient often suffers from chronic synovitis of one or more of the large joints. The knees are most frequently affected, and there may be free effusion lasting for some weeks, but not often attended by much pain. Almost invariably the effusion disappears, and the joint is perfectly restored. These joint-affections may occur either before or after the keratitis, and sometimes in those who never suffer from the latter.

Periosteal affections of the long bones are at this stage not uncommon, and sometimes very severe. They may occur in any part of the skeleton, and often produce numerous and large nodes. If near to joints, these nodes may produce much crippling of movement. If situate on the shaft, they may produce an appearance of curving, which, in former times, used to be mistaken for rickets. Overgrowth of the bone in length, as well as thickness, is an almost constant result of this form of periostitis, since it often persists for years. This overgrowth, if one tibia only be affected, may produce an increase of length in relation to the other of an inch or inch and a half, and constitutes, with the bending, one form of the malady known as osteitis deformans. Sometimes almost all the long bones in the body are simultaneously affected by these ossifying nodes. The skull, however, at this stage of the malady, but rarely suffers. Occasionally suppuration attends the periostitis, and a surface of diseased bone, roughened and much thickened, is exposed. The condition produced may usually be diagnosed from other forms of suppurative periostitis with necrosis, by the circumstance that the exposed bone is not enclosed by any shell of new bone, that it is extremely slow to separate, often remaining visible, but firmly fixed, for a year or more. The periosteum and cellular tissue overlying it are usually destroyed.

At the stage of the disease of which we are speaking, nothing is less common than for any special affection of the skin to occur. The only eruption which can happen is a form of rapidly destructive lupus. No scaly or papular eruptions, and nothing in the least resembling common lupus, or the serpiginous ulceration so common in the acquired disease, are—with the very rarest exceptions—observed. Nor are any forms of disease of mucous surfaces of the tongue or the palate at all frequently seen. It may be asserted also that affections of the viscera are very exceptional, and diseases of the nervous system scarcely less so. A few cases of ophthalmoplegia, and a few of epilepsy, apparently in connexion with inherited taint, are on record, and a few also in which the grey matter of the hemispheres appeared to suffer, and a state approaching idiotcy was the result; but all observers agree that they are very infrequent.

The subject of such taint having passed through the attack of keratitis, attended, it may be, by periostitis or loss of hearing, usually afterwards regains fair health, and continues through the rest of his life free from symptoms. No diseases likely to shorten life have been associated with the diathesis; above all we may assert that there is no special proneness to diseases of the scrofulous or tuberculous class. Year by year usually the physiognomical and other characters of the diathesis become less and less obvious, and in advanced life it may be very difficult to recognise it.

No trustworthy evidence in support of the suspicion that the subjects of inherited taint can in turn transmit it to their children at present exists. Most of the facts recorded have been published by the writer. It is perfectly certain that those who have themselves suffered very severely may become the parents of children who appear to be in every respect healthy. There is neither evidence nor probability in support of the conjecture that syphilis is, in the third or fourth generation, the cause of any chronic diseases of the skin or of scrofula.

Such being the general picture of the course and final results of inherited syphilis, it remains to notice certain facts which are more or less exceptional to what has been said. Although it is true that for the most part the taint does not appear to affect the infant until some time after it has commenced independent existence, yet there are numerous instances in which it causes intra-uterine death. Thus, abortions and miscarriages at various periods of pregnancy are common in syphilitic mothers. It is quite possible, however, that the influence of syphilis in this direction has been exaggerated. It is also possible that the cause of what happens to the fœtus is, in such cases, due rather to disease of the mother, and perhaps of the placenta, than to the breeding of the syphilitic virus in the fluids of the fœtus itself. If this be not so, it is exceedingly difficult to explain why the majority of syphilitic infants should be born plump and well-nourished, and remain for a month or so without symptoms, whilst others, on the contrary, perish at, it may be, an early period of intra-uterine life. Enough of pathological evidence has, however, been recorded to compel us to admit that the fœtus may itself suffer from syphilis, and may exhibit lesions of the viscera, bones, or skin which conclusively denote it. Such lesions are, however, rare. It is a most noteworthy fact that, if syphilis affects the fœtus it almost invariably causes its death, for nothing is less common than for an infant to be born alive with extant signs of taint. Three weeks or a month almost invariably intervene before the eruption, snuffles, &c., appear. A very perplexing exception to this occurs in the case of what is known as infantile pemphigus. In this disease the eruption may appear, in an apparently healthy child, within a day or two of birth, and the case may end in death within a week. These cases need further investigation, and it is hopeless, in our present state of knowledge, to attempt to explain them.

Diagnosis.—It will be convenient to treat of diagnosis under different heads according to the age attained by the infected child.

1. *In the fœtus and at the time of birth.* — It is probably far too hastily assumed that if a dead fœtus presents a peeling skin, and is shrivelled, it has probably died from syphilis. Such conditions are common whenever death has occurred long before expulsion. So also, as has been already hinted, is the belief that miscarriages imply syphilis held probably far more widely than facts warrant. Miscarriages are common from many other causes, and, conversely, it is quite certain that many mothers, suffering severely from syphilis, carry their infants easily to full term, and produce them in a viable condition. The recognition of syphilis in a dead and possibly decomposing fœtus is a matter of great difficulty and uncertainty. As to the existence of signs of syphilis in living infants born at full time, we must receive the published testimony of the older surgeons with caution. Not having the importance of this special point in mind, they often assumed, on seeing a syphilitic infant, that it had been born with the symptoms. Obstetricians would probably give evidence of a different kind. Thus, whilst Diday, who had enjoyed very extensive opportunities of special observation, had never seen signs of syphilis present at birth, we find Sir Astley Cooper stating that he had seen several children born with copper-coloured eruptions on the palms, soles, and buttocks. Probably all that he meant is that the infants were young when seen. The writer has never himself seen an infant born with a syphilitic eruption, or one in whom the evidence was clear that such an eruption was present at birth. In spite, however, of some scepticism, the facts must be accepted that such infants are occasionally seen. Rondelet, Doublet, Gilbert, Guérard, and Landmann are all quoted by Diday as having published single cases in which infants were born with characteristic eruptions. Visceral disease, as of the liver, spleen, thymus gland, &c., has also been encountered under conditions implying that the poison had been actively at work in the fœtal organism during intra-uterine life.

2. *During Early Infancy.*—In many cases the recognition of inherited syphilis at the age of six weeks or two months is exceedingly easy. The stuffed and expanded nose, the snuffles, the pallor, the patches of peeling erythema about the face, neck, and nates, constitute a picture which can scarcely be mistaken; but which is yet often heightened by such symptoms as sores at the angles of the mouth and anus, a peculiar odour, and periosteal tenderness of various bones. In many cases, however, one or several of these symptoms may be omitted or ill-marked, and in some they are all of them so. In certain instances, therefore, it is to be admitted that the diagnosis may become very difficult or even impossible. In such cases help must be sought from the parents' history, and from facts, if there are any, as to previous births. In doubtful cases each one of the symptoms must be scrutinised with suspicion. Infants often have a certain kind of snuffles who are not syphilitic, and common eczema of the nates may assume exactly the same tint as that which is specific. Sores, in connexion with diarrhœa, may occur at the anus, which may be mistaken for condylomata. It is seldom safe to trust to any one symptom unless it is very well characterised. A typical condyloma is conclusive, and so also of certain types of skin-eruption, and certain forms of bone-disease.

For a knowledge of the conditions of periostitis which denote syphilis in the infant, we are indebted to very recent observations. When M. Diday, in 1856, wrote his work on this disease, he stated that the records of medicine comprised scarcely any instances of bone-disease in connexion with inherited taint. At the date of the writer's own work, 1863, he had recognised the frequency of nodes in later periods of life, and the occasional occurrence of periostitis in infants. It was reserved, however, for Dr. Taylor, of New York, Dr. Wagner, of Berlin, and Professor Parrot, of Paris, to show that bone-lesions were really very frequent at early periods. They had been overlooked because they were usually—like the other phenomena of this stage—transitory, and because they but rarely led to suppuration. The careful investigation in this country by Drs. Barlow and Lees of the opinions expressed by Professor Parrot, have confirmed the correctness of these in the main, whilst they have corrected certain errors of inference. *See* CRANIOTABES. The chief difficulty consists in the similarity which some of the infantile bone-lesions of syphilis present to those of rickets. As a rule, however, the syphilitic lesions occur at an earlier age, are attended by more definite signs of inflammation, and are not accompanied by the other phenomena of rickets, such as profuse sweating of the head, and buttons on the costal cartilages. Congenital syphilis and rickets very often co-exist; but there is no reason for believing that the one is in any sense the cause of the other. For purposes of diagnosis it may be sufficient to state that, in infants suffering from syphilis, it is very common to find certain areas in the skull tender and slightly swollen, and the regions of the epiphyses of long bones often suffer in a like manner. These lesions are often multiple, and may make all movements of the limbs so painful that paralysis may be suspected. Careful examination will always detect tender swellings of periosteum near to the junctions of the epiphyses, and sometimes on the shafts. These swellings are often of considerable size, much larger and, at the same time, more inflamed than those of rickets. Suppuration is not common, but it does occasionally occur. If this form of multiple periostitis is seen within six months of birth, it is almost certainly due to syphilis.

The state of nutrition is no safe guide in cases of doubtful diagnosis. In those which are self-evident it is often very characteristic. The infant is puny, emaciated, and shrivelled, and has features which resemble those of an old man. It is not uncommon, however, for syphilitic infants to remain throughout plump and healthy-looking. In doubtful cases reference may be made to the state of the palms and soles, which often show peeling patches, and to that of the nails, which sometimes become malformed and look as if they had been pinched laterally.

3. *At periods of life subsequent to infancy.*—After the infantile phenomena have passed away—roughly speaking after the end of the first year—the recognition of the subjects of inherited syphilis will depend—1st, upon certain structural peculiarities which have been left as the results of the secondary lesions; and 2nd, upon the occurrence of new local inflammations which are characteristic of the disease. To take the latter first, it may be broadly stated that if a child or young person, without either ear-ache or otorrhœa, becomes quickly and completely deaf, it is almost certainly syphilitic. In like manner the same diagnosis becomes almost certain if it shows well-characterised and symmetrical interstitial keratitis, or erosive lupus, or ulceration of the palate. Respecting each of these lesions, the exceptions to the statement that they are due to inherited taint are very few indeed. Such is also the clinical fact respecting multiple chronic nodes of long bones, and disseminate choroiditis.

Under the head of marks left by secondary lesions, we have to describe the hereditary syphilitic physiognomy, the peculiar features of which were first characterised by the writer, although he was not fortunate enough to assign all correctly to their true causes. This physiognomy consists, in the first place, of a peculiarly square forehead, with prominent frontal eminences and shallow furrows beneath them; a flattened and wide bridge of nose; a pale, soft, muddy skin, with little scars or pits in it; and radiating scars about the mouth, especially at the angles. To these we must add—as of yet higher value than any or even all of them—that the upper central incisor teeth, of the permanent set, usually show a single vertical notch, and are dwarfed in all their dimensions, but especially as to width. Other malformations of the teeth, and especially of the other teeth, are usually present also, but are indicative rather of the specific treatment which the child has required in early infancy than directly of syphilis. Hence it follows that in other cases than syphilis, if for any reason mercury has been much given, similar malformations may be present. Under this head reference is made to defects in enamel, to horizontal markings, to warty growths on the free edge, and to what are known as honeycombed teeth. The upper central incisors are the only teeth upon the malformations of which reliance can be placed. When their notches are well-marked the condition is, the writer believes, quite pathognomonic. Great caution must, however, be exercised in appreciating their peculiarities.

In many patients the physiognomy of hereditary syphilis is rendered more easy of recognition by the fact that the patient has already passed through an attack of keratitis. Such attacks often leave, for long periods, a certain slight degree of haze of the corneal structure and a peculiar steel-grey tint of the iris, which very much assist the diagnosis. If the recognition is difficult the ophthalmoscope should be used, and the periphery of the fundus carefully explored. If conditions resembling either disseminate choroiditis or pigmented retinitis are discovered, the diagnosis of syphilis is made highly probable.

Treatment.—The principles of treatment of inherited syphilis may be very briefly expressed. Mercury should be given, cautiously but efficiently, in all stages of the disease. If the patient be feeble and cachectic there is the more need for the remedy, though of course the greater must be the care taken that it does not disagree. The infant must be judiciously and liberally fed during the course. As a rule iodide of potassium is both more depressing and far less efficient than mercury, and should be avoided. It must be admitted, however, that we have, in the risk of damage to the teeth, a reason against the use of mercury. This risk is so considerable that, in cases in which the symptoms are but slight, and the child's health not suffering, it may be right either to avoid specifics, or to use only the iodide. This remark applies only to infancy, whilst the permanent teeth are as yet uncalcified. In all the later periods there is no objection to mercury. Especially ought mercury to be speedily pushed if deafness is threatened. It is quite true that it does not arrest the progress of the lesions due to inherited taint in the same definite and speedy manner in which it subdues those of the acquired disease. Notwithstanding this admission, the writer is sure that its use is generally very advantageous, and that we usually err in not giving it sufficient confidence. Inunction is the safest plan, especially in infants, but it may be given internally, in the form either of grey powder or the solution of bichloride. The dose must vary with the age and strength of the child. It is well to begin with very small doses, and to increase until definite effects are produced, either of disorder to health or disappearance of symptoms. The oleate of mercury, 10 or 15 per cent., is very convenient for inunction, and less likely to excite suspicion than the ointment. If given by the mouth, small doses frequently repeated are much to be preferred to large ones.

It goes without the need of saying that the utmost attention is to be given to the general health of the syphilitic infant. As a rule the mother should be the nurse, and her diet should be liberal and carefully regulated. If the mother cannot nurse, then artificial food, cow's milk, or still better, that of asses, must be given. On no account, under no circumstances, and with no precautions, must a healthy wet nurse be allowed to take a syphilitic infant. The risk of nipple infection is far too great. In this respect the child's own mother is in no danger.

The attempt to treat the child through the mother's milk by administering to her either mercury or the iodide, is a roundabout and inefficient plan. It is sometimes resorted to in cases of extreme debility on the part of the infant, but even in these it is probably more likely to disagree and less likely to cure than a mild inunction would be.

The treatment of the fœtus in utero is often carried out by means of the administration of mercury to the mother, and probably with success. If a woman who is known to have had syphilis within two years become pregnant, she ought, for the sake of her child, to take mercury during most of her pregnancy. For this purpose the grey powder in doses of a grain, three times a day, is probably both efficient and harmless. If the mother be robust, larger, or, still better, more frequent doses may be desirable. The writer has recently seen an infant suffer very severely indeed from syphilis, whose mother had, under the advice of a distinguished obstetrician, taken minute doses of the bichloride through almost her whole pregnancy. Thus we are warned that to be efficient the course must be a real one. Whenever in married life a syphilitic infant has been produced, it is desirable that both parents should be put under treatment, with a view to the safety of future conceptions. There is a drawback to the administration of mercury to a woman actually pregnant, that it may damage the development of the infant's teeth (first set). This makes it the more desirable that the mother should be well treated with the specific before conception.

Jonathan Hutchinson.

CONICAL CORNEA. *See* Cornea, Variations of Curvature of the.

CONICAL STUMP. *See* Stumps, Affections of.

CONJUNCTIVA, Diseases of the.—Hyperæmia of the Conjunctiva.—*Causes.*—The presence of foreign bodies in the conjunctival sac. Impure or irritating atmospheres, e.g. air charged with coal or tobacco smoke. Alcoholic excesses, stenosis lacrymalis, and other forms of lacrymal obstruction. The use of unsuitable spectacles, or the use of the eyes for near work without spectacles when the condition of the accommodation requires them, e.g. in hypermetropia, and in presbyopia.

Pathology.—The blood-vessels of the palpebral rather than those of the bulbar conjunctiva become engorged, slight chemosis sometimes appears, small vesicles may form, and there may be some swelling of the papillæ, and development of lymph-follicles.

Symptoms.—These consist of lacrymation and photophobia, with hot, burning sensations, and a feeling as of a foreign body or sand in the eye, and the eyelids are heavy. All these symptoms are aggravated in artificial light.

Diagnosis.—The only disease for which this condition is likely to be mistaken is simple catarrhal conjunctivitis, of which the symptoms are very similar; but in the latter there is more or less discharge from the mucous membrane, while in hyperæmia of the conjunctiva there is none.

Treatment.—In addition to removal of the cause, the use of iced compresses to the closed eyelids for twenty minutes several times a day, and the instillation of a drop of tincture of opium and distilled water in equal parts once daily, will be found very beneficial. It is also desirable to clear out the lacrymal passages with a stream of fresh water from an Anel's syringe, even where no decided lacrymal obstruction is present.

Conjunctivitis (in general).—In addition to hyperæmia of the mucous membrane, abnormal secretion is here present. There are several forms of conjunctivitis, the secretion from each being, more or less, contagious. Infection may take place either by the direct application of the secretion, or through the air, in which float particles of the infecting substance. The former is the more common mode, but the latter is liable to occur in ill-ventilated rooms, where some people affected with conjunctival disease are present with others possessing healthy eyes.

Catarrhal Conjunctivitis (Simple Acute Conjunctivitis). — *Causes.* — Draughts of cold air, contagion, foul atmospheres, foreign bodies, as a sequel of or attendant on scarlatina, measles, or smallpox.

Pathology.—The hyperæmia of the conjunctiva is here well-marked, often concealing the Meibomian glands, and extending sometimes over to the bulbar conjunctiva as far as the cornea. Enlarged papillæ and lymph-follicles are often present, but not necessarily so. There is a sticky, serous discharge, which sometimes produces ulceration of the intermarginal portion of the eyelid. If the catarrh becomes chronic the papillæ become more developed, while the blepharitis is apt to extend over to the cutis, causing eversion of the lower punctum lacrymale with resulting stillicidium, and this, in its turn, aggravates the conjunctival affection.

The *Symptoms* are very much those of a severe case of hyperæmia (sensation of sand in the eye, hot, burning sensations, weight of eyelids), with the addition of the annoyance caused by the secretion, which gums the patient's eyelids together on his awaking in the morning and, by coming across the cornea, causes momentary clouding of the sight. Photophobia may be present, but is not usually severe unless there be some corneal complication. The latter, sometimes, is seen in the form of minute marginal infiltrations which rarely attain to very serious dimensions, but rather disappear as the conjunctiva becomes normal.

Diagnosis.—The presence of the gummy secretion distinguishes this affection from mere hyperæmia of the conjunctiva. A common mistake amongst those not familiar with eye-disease is to regard a case of iritis as one of simple acute conjunctivitis, the 'redness' of the white of the eye in the former affection being taken for conjunctival hyperæmia, &c., and, moreover, a slight secondary conjunctivitis does, undoubtedly, attend many cases of iritis. The circumcorneal subconjunctival vessels are those which become engorged in iritis, and the conjunctival vessels may be distinguished from them by the possibility of moving them, along with the membrane in which they are, by manipulations which can be made with the lower lid of the patient, but these manipulations do not affect the subconjunctival vessels. The condition of the iris itself, however, is that upon which the diagnosis chiefly depends. *See* Iris.

The *Prognosis* is good unless there be reason to suspect that the mild form is but the commencement of a more severe inflammation.

Treatment.—At the first onset nothing more than iced compresses, used intermittently (twenty minutes every two hours), should be employed, and in mild cases this alone soon brings about a cure. On the second or third day the application, with a camel's-hair pencil, of a solution of five to ten grains of nitrate of silver to one ounce of water by the surgeon to the everted palpebral conjunctiva, is to be recommended; provided it be immediately and thoroughly neutralised by the application of a saturated solution of common salt to the conjunctiva —to prevent too severe a reaction—the whole being washed off finally with plain water. A few daily applications of this kind are usually enough to cure these cases.

Iced compresses, or cold sponging, immediately after the dressing, relieve the smarting.

The greatest care is required in the use of nitrate of silver in conjunctival affections for any prolonged period, lest it cause staining of the membrane; thorough neutralisation and washing, as above recommended, being the best precautions. The writer is opposed to the use even of weak solutions of nitrate of silver as eye-drops to be used at home by the patient, for staining is very apt to be caused in this way.

Should the surgeon be unable to see the patient daily, the following well-known eye-drops are capable of effecting a rapid cure in most cases: ℞ Acid. boracic. gr. viii., Zinci sulph. gr. iv., or Tinct. opii fʒij., Aq. destill. ad f℥ij.; one drop in the eye once a day. Solutions of sulphate of alum (gr. iv. to f℥j. of water) and of tannic acid (gr. v.–viii. to f℥j. of water) are often prescribed, but are not so effectual as the foregoing.

Follicular Conjunctivitis. — *Causes.* These are much the same as in simple catarrhal conjunctivitis. The long continued use of either atropine or eserine is liable to bring about the disease.

Pathology.—The condition of the conjunctiva is that found in catarrhal conjunctivitis, with the addition of small, oval, pinkish bodies the size of half a carraway-seed, which disappear completely as the disease passes off, leaving the mucous membrane as healthy as they found it. These little bodies are situated chiefly in the fornix of the conjunctiva, especially of the lower lid, and may be seen, on eversion of the latter, arranged in rows parallel to the margin of the lid. Whether they be easily discovered or not depends on their size and number, and on the amount of co-existing hyperæmia or chemosis of the conjunctiva. The structure of these bodies shows them to be lymph-follicles. They have no relationship to the granulations of granular ophthalmia, although some authors have regarded them as an initial stage of the latter.

The symptoms are much the same as those of catarrhal conjunctivitis. Frequently there is little or no injection of the conjunctiva, and the chief symptom is asthenopia—an inability to continue near work for any length of time—and much distress in artificial light. The presence of even a few follicles in the conjunctiva may cause annoying symptoms of this kind. Between the fifth and fifteenth years of age is the time of life most liable to it.

Prognosis.—Follicular conjunctivitis is a most tedious form, lasting often for months, and this is the most serious point in connection with it. Slight marginal infiltrations and ulcers of the cornea sometimes occur in its course.

Treatment.—The most useful remedy is an ointment of sulphate of copper of from gr. ss. to gr. ij. in ʒj. of vaseline. The weaker ointment should be used at first, and later on the stronger ones, if it is found that the eye can bear them. A piece of ointment of the size of half a pea is inserted into the conjunctival sac with a camel's-hair pencil once a day. Eye-drops of equal parts of tincture of opium and distilled water are of use in some cases, and the eye-douche should be recommended. Abundance of fresh air, with change from a damp climate or neighbourhood, if the patient live in such, to a dry one, are of importance. If the use of atropine has induced the disease, it should be discontinued, and, if a mydriatic be still required, a solution of extract of belladonna (gr. viii. ad f℥j.) may be employed in its stead.

Spring Catarrh is the eye-complication which accompanies 'hay fever.' It is not, strictly speaking, a catarrhal affection, for it is usually unattended by secretion, and the prefix 'spring' is misleading, as it is seen also in summer and autumn. The hay harvest is the most common period for it, owing, probably, to certain minute particles which then float in the air.

Pathology.—The bulbar conjunctiva is chiefly affected. It becomes injected, slightly œdematous, and close around the cornea somewhat elevated, with greyish swellings. The microscope shows (Uhthoff) that this swelling is due to hypertrophy of the epithelial layer of the conjunctiva in this situation, combined with subepithelial infiltration with a substance which is, or is similar to, coagulated albumen. The connective tissue layer of the conjunctiva remains tolerably normal.

Symptoms.—The chief symptoms are photophobia and lacrymation.

Some persons are liable to be attacked at each hay harvest.

Treatment.—Dark glasses for protection from the light. Weak astringent collyria (sulphate of zinc, acetate of lead). Or, iodoform ointment (1 in 15), a little put into the eye once a day. Massage applied twice daily, in conjunction with strong precipitate ointment, is a treatment recommended by some. Occasional cold sponging, or the eye-douche, are grateful to the patient.

Granular Conjunctivitis, Granular Ophthalmia, or Trachoma.—This disease occurs in two forms, the acute and the chronic.

Causes.—The disease is regarded as very contagious. The acute form is said to be often epidemic in places where the hygienic conditions are bad, but it has not come under the notice of the writer in this form. He has seen only some sporadic cases. The chronic form is much more common. It is very frequent in countries where the dwellings are overcrowded and dirty, and where the climate is damp, as is the case in Ireland amongst the lower orders. Amongst the better classes of all countries the disease is very uncommon. High, dry, mountainous countries are almost free from the disease. Some believe that it is dependent upon constitutional disease, such as scrofula, tuberculosis, syphilis, &c., but this is incorrect. No doubt many of these patients are anæmic and out of health; but this is due to the moping habits they contract and the little open-air exercise they take, in consequence often of their semi-blindness.

Pathology.—In this disease, in addition to the usual appearances of simple conjunctivitis, there are developed greyish or pinkish-grey bodies in the conjunctiva, each about the size of the head of a pin or larger. They attack, especially, the fornix conjunctivæ of the upper lid, but are also found disseminated over other parts of the palpebral membrane. They do not attack the bulbar conjunctiva. These bodies are the 'granules' or 'granulations,' and in the acute form of the disease they somewhat resemble the follicles of follicular conjunctivitis, but are paler, not so apt to occur in rows, and are more isolated. Microscopically the granulations have no capsule, as have the follicles, but seem to grow from, or in, the stroma of the conjunctiva. In the acute form the granulations consist of lymph-cells alone; but in the chronic form this is the case only towards their surface, while at their bases they are formed chiefly of connective tissue. Sattler has discovered the presence of a peculiar micrococcus in the interior of the granulations and in the secretion, and to this probably is due the marked infectiousness of the disease. The danger associated with these granulations, and one of the chief dangers of the disease, is the tendency they have to produce cicatricial degeneration of the mucous membrane. In some cases the whole conjunctiva is destroyed; and xerophthalmia, which may involve even the bulbar conjunctiva, may come on, but this is not very common. A more frequent result is that the submucous tissues, including the tarsus of the eyelid and the bulbs of the eyelashes, become secondarily affected, with resulting entropion, distichiasis, and trichiasis.

An affection of the cornea, termed *pannus*, is very frequently seen as a result of granular ophthalmia. Its occurrence does not seem to depend on the severity of the conjunctival disease, for it may be found in slight cases of the latter, or at least where the granulations and consequent conjunctivitis are not very markedly developed. This pannus consists in opacity and superficial vascularisation of the cornea, and always commences in its upper half. *See* Cornea, Inflammation of the.

Symptoms.—In acute granular ophthalmia there is often a great deal of swelling of the upper lid, great injection of the whole of the bulbar and palpebral conjunctiva, and swelling of the papillæ with development of the characteristic granulations. There may be but little discharge, but there is generally much lacrymation, with photophobia and pain in the brow and eye. Superficial marginal ulcers of the cornea may form. The inflammation and papillary swelling is, sometimes, almost absent in the very commencement. Soon, however, they appear and gradually increase to such an extent as to hide the granulations from view, and then, taking on a blennorrhœic form, the process gradually subsides, until, in the course of two or three weeks, it quite disappears, having brought about absorption of the granulations, and ultimately the mucous membrane is left in a healthy state. If, however, in the blennorrhœic stage, the inflammation be severe, the eye may run all the dangers of an attack of acute purulent conjunctivitis. Or, if, on the other hand, the inflammation be very slight, it may not be sufficient to effect absorption of the granulations, and the process may run into the chronic form.

In chronic granular ophthalmia the first onset of the disease is often without inflammation, and is then unattended by any distressing symptoms, except that the eye may be more easily irritated by exposure to cold winds, foreign bodies, &c., or more easily wearied by reading and other near work. If such a case come under our notice, the conjunctiva will be found free from injection and swelling, but greyish-white semitransparent granulations of the size of a rape seed, or less, will be seen disseminated over the palpebral conjunctiva and protruding from it. Gradually these granulations, acting as foreign bodies, give rise to a more or less active vascular reaction, attended with swelling of the papillæ—in short, to blennorrhœa of a chronic form. The patients then begin to be more inconvenienced, owing to the discharge, which obscures their vision, and to sensations of weight in the eyelid and of foreign bodies in the eye, and this is generally the earliest stage at which we see the disease. The enlarged papillæ sometimes grow to a great size, completely hiding the granulations. In this stage the granulations may become absorbed, and the disease undergo cure, but more commonly it makes further progress. Fresh granulations appear, while the old ones increase in size, until they often become confluent, leaving only here and there an island of vascular mucous membrane, and the stage of cicatrisation is present.

At any period prior to cicatrisation of the conjunctiva an attack of purulent blennorrhœa is liable to come on. If not too severe, this may result in cure by absorption of the granulations, and should not be checked. If, however, the attack be very severe, the eye runs dangers similar to those of an ordinary attack of purulent conjunctivitis. These dangers are less, the more complete and the more intense the pannus.

Prognosis.—On the whole, if the disease come under treatment at an early period, it may be hoped that vision will be retained in the majority of cases, although a radical cure may be difficult or impossible. These cases require to be under constant or intermitting treatment for long periods, often for years.

Treatment.—The aim of this is to bring about absorption of the granulations with the greatest possible despatch, in order to prevent the destruction of the mucous membrane to which they tend. No caustic application should be made with the object of directly destroying the granulations, for this can only be done at the expense of the mucous membrane around them. If at the first visit any difficulty be found in everting the upper lid, it is advisable, in bad cases of granular ophthalmia, acute or chronic, to at once perform a canthoplastic operation (*see* Eyelids, Diseases of), as this tightness of the eyelid is an obstacle to the cure.

In acute granular ophthalmia it is desirable to abstain from active measures in the commencement of the affection, owing to the tendency to natural cure which is often present, and, in particular, astringents and caustics should be avoided. At the utmost an antiseptic lotion of boracic or salicylic acid, and cold, or iced, applications for relief of the pain and heat, are admissible. Dark protection-glasses are agreeable, and, wearing them, the patient should be encouraged to take open-air exercise. But, if it be evident that the inflammatory reaction is too sluggish, poultices or warm fomentations should be employed to promote it. Once the blennorrhœic stage has been reached, great care is required to control it, and, if it threaten to exceed safe bounds, it must be restrained by means of suitable applications, such as acetate of lead, nitrate of silver, or sulphate of copper in solutions of medium strength; or it may be necessary to use them in strong solutions, or even to employ the solid mitigated nitrate of silver, according to the severity of the blennorrhœa.

In chronic granular ophthalmia, as already stated, the occurrence of a blennorrhœic attack often produces marked improvement. Following the hint nature thus gives us, we should endeavour by our treatment to produce a certain papillary reaction (blennorrhœa). For chronic cases, with little swelling of the papillæ and with little or no cicatrisation, the best application is the solid sulphate of copper lightly applied to the conjunctiva, especially at its fornix, but, when there is considerable papillary swelling, the writer prefers a 10 grain to Aq. f℥j. solution of nitrate of silver, properly neutralised, after application, with a solution of salt. An interval of twenty-four hours, at least, should be allowed to elapse between each application, whether of sulphate of copper or nitrate of silver, and cold sponging for fifteen minutes should be employed immediately after the application. A change of treatment will be required occasionally, even if the remedy first used answer well in the beginning, and one of the following can be adopted:—Liq. plumbi acetatis dil., never to be used except with everted lids, and washed off with plain water by the surgeon, and not even in this way if there be ulcers of the cornea, as a deposit of acetate of lead on the ulcer is liable to occur. Tannin ointment: tannin, gr. iij., vaseline, ʒiij.; a piece the size of half a pea to be put into the eye once a day. Sulphate of copper ointment: same strength as the last, and to be used in the same way. Solution of alum: gr. x. to f℥j. of distilled water; one drop in the eye once a day. Where an active pannus is present, a drop of solution of atropine should be instilled into the eye once a day, as a precaution against iritis.

Some surgeons employ scarifications of the conjunctiva when it is much swollen and the papillæ too exuberant, but the writer has not adopted them, fearing the resulting cicatrices. Again, it has been proposed to excise or abscise the granulations. This may, perhaps, be allowable if they are isolated and protrude much over the conjunctival surface. Electrolysis has been employed for the destruction of the granulations, but the method has not as yet been generally adopted. It is worthy of further trial. The negative pole, in the form of a needle, is plunged into the granulation, while the positive pole is placed either on the temple or other adjacent region.

Inoculation of the conjunctiva with pus from a case of blennorrhœa neonatorum has been much practised in Belgium, especially in cases of severe pannus. By this means a violent acute blennorrhœa is set up, which is then guided to a cure; and, when it has subsided, the granular ophthalmia and pannus should have disappeared. This method is attended with considerable danger to the cornea, even where the pannus is well developed, and has not, therefore, found general acceptance.

Infusion of jequirity (*Abrus precatorius*, Paternoster-bean), long used in the Brazils, has been introduced to the notice of European surgeons by De Wecker. A 3 per cent. infusion is applied morning and evening, or even three times daily, for two or three days. The affected eyelids are everted, and the infusion is applied plentifully to the conjunctiva with a sponge, or it may be rubbed into the mucous membrane. The result is a purulent ophthalmia of a somewhat croupous tendency (the cornea being hidden by a false membrane), accompanied by great swelling of the eyelids, much pain and considerable constitutional disturbance, rapid pulse, and a temperature of 100° or more. In the course of eight or ten days the inflammation subsides, and the cornea is then, in many cases, found free from pannus, or almost so, while complete cure of the granular ophthalmia itself is rarer. Iced compresses to the lids should be used during the inflammation. A fresh infusion (not more than seven days old) must be used, in order to have the most certain effect from the application. The majority of surgeons find the remedy perfectly harmless, if not always very efficacious; but a good many cases are on record where violent diphtheritic conjunctivitis, followed by blennorrhœa of the conjunctiva, and by more or less extensive ulceration and destruction of the cornea, and even complete loss of the eye, was produced. De Wecker regards the presence of a purulent discharge from the conjunctiva as a contra-indication for the remedy, which, he finds, is then liable to increase the intensity of the blennorrhœa in a dangerous degree. Cases where there is little or no papillary swelling, but nearly dry granulations with pannus, are the most suitable for its use. The presence of well-marked pannus of the cornea without ulceration is, in the opinion of a large number of surgeons, the only thing which can render the employment of jequirity justifiable, and, in addition to this, the conjunctiva should be free from blennorrhœa.

In addition to local remedies, it is of the utmost importance that the hygienic surroundings of patients suffering from granular ophthalmia be seen to, and that they be obliged to spend a considerable time daily in the open air.

Purulent Ophthalmia. — *Causes.* — The two most common forms in which we find this affection are, as gonorrhœal ophthalmia, and as ophthalmia neonatorum. In the former the etiological element is the introduction of some of the urethral or vaginal discharge into the conjunctival sac, while in the latter the infection is believed to take place, as a rule, during the act of birth, by an abnormal secretion (not necessarily gonorrhœal) of the vagina finding its way into the infant's eyes. For, although the eyelids are closed during birth, they are not so tightly closed as to preclude the possibility of fluid making its way between them. Ophthalmia neonatorum may also be the result of inoculation taking place after birth by pus conveyed by the fingers of the mother or nurse, or by towels, &c., used for washing the child's face. It is never due to mere exposure to strong light or to cold, as is popularly supposed. Acute conjunctival blennorrhœa also comes about without any assignable cause; but, in all these cases, it is probable that the introduction of some septic matter into the eyes has taken place, although without the knowledge of the patient.

Pathology.—Neisser, who first observed the presence of a peculiar micrococcus in the gonorrhœal discharge, also found the same micrococcus in the pus from the conjunctiva in cases of gonorrhœal ophthalmia, and it was thought that this might account for the remarkable virulence of this ophthalmia; the same micrococcus, however, has been found in the conjunctival discharge in ophthalmia neonatorum.

Symptoms and Progress.— In mild cases the bulbar conjunctiva may be but little, or not at all, affected; the palpebral conjunctiva alone becoming velvety and discharging a small amount of pus, while there may be no swelling or œdema of the eyelids. Such mild cases are not uncommon in ophthalmia neonatorum. In severe cases of blennorrhœa of the conjunctiva there is, soon after the onset, serous infiltration of the palpebral mucous membrane, which consequently becomes tense and shiny; serous chemosis of the bulbar conjunctiva, serous discharge, swelling of the eyelids, making it difficult to evert them, pain in the eyelids, often of a shooting kind, burning sensations in the eye, and photophobia. This first stage lasts from twenty-four to forty-eight hours, and then begins the second stage, in which, owing to swelling of the papillæ, the palpebral conjunctiva becomes less shiny and more velvety, while the discharge alters from serous to the characteristic purulent form, the chemosis, however, remaining unaltered, or becoming more firm and fleshy. The swelling of the lids continues, the upper lid often becoming pendulous and hanging down over the under lid. Gradually the chemosis and the swelling of conjunctiva and eyelids subside, and the discharge lessens, the mucous membrane being left in a normal state, unless in a small percentage of cases in which chronic blennorrhœa remains. A severe attack of conjunctival blennorrhœa lasts from four to six weeks.

Complications with secondary corneal affections are the great source of danger in this affection. They occur in four forms: —1. Small losses of epithelial tissue on any part of the cornea. If these occur at the height of the inflammation, they are apt to go on to form deep perforating ulcers. 2. The whole cornea becomes opaque (diffusely infiltrated), and towards its centre some greyish spots form, which are interstitial abscesses or purulent infiltrations. 3. The infiltration may form at the margin of the cornea, and extend a considerable distance around its circumference, giving rise to a marginal ring ulcer, and, later on, to sloughing of the whole cornea. 4. A clean-cut ulcer may form at the margin of the cornea without any purulent infiltration of the corneal tissue, and may also extend a long way round the cornea. Such ulcers are particularly apt to occur where there is much chemosis which overlaps the margin of the cornea, and, being hidden in this way, these ulcers are easily overlooked. The chemosis should be pushed aside with the point of a probe, and these peculiar ulcers sought for. They are very liable to perforate. See *Suppurative Keratitis*, under Cornea, Inflammation of the.

All the foregoing forms of secondary corneal affection are common to ophthalmia neonatorum and gonorrhœal ophthalmia, but the two last are more frequent in gonorrhœal ophthalmia than in that of the newborn. They may appear at any period of the affection, but the earlier they occur the more likely they are to result seriously.

Treatment.—In the commencement of the affection the only local applications admissible are antiseptic lotions and iced compresses. The conjunctival sac should be frequently washed, not syringed out, with the former. In syringing out the conjunctival sac a morsel of the corneal epithelium may be removed, and through this the cornea become infected, and consequently this method is objectionable. The iced compresses should be kept to the eye for an hour at a time, with a pause of an hour, and so on, or even continuously. In this and in the next stage the chemosis should be freely and daily incised with scissors. If the swelling of the eyelids be great, the external canthus should be divided with a scalpel from without, leaving the conjunctiva uninjured; by which means the tension of the eyelids on the globe is reduced, and, by bleeding from the small vessels, depletion of the conjunctiva is effected. If, in adults, the degree of chemosis, palpebral swelling, and rapidity of the onset, indicate that the inflammation is severe, the writer is in the habit of placing the patient quickly under the influence of mercury, by means of inunctions or small doses of calomel, as, by this means the chemosis is often rapidly brought down, and one source of danger to the cornea removed. He does not use mercury in ophthalmia neonatorum.

In the second stage, i.e. when the conjunctiva has become velvety and the discharge purulent, caustic applications are the most trustworthy, and in this respect iodoform, and other lauded means, cannot compete with them. The application employed may be a solution of nitrate of silver of 15 to 20 grains in f℥j. of water, which should be applied by the surgeon with a camel's-hair pencil to the conjunctiva of the everted lids, and neutralised with a solution of common salt. Or, the solid mitigated nitrate of silver (one part nitrate of silver, two parts nitrate of potash, in the solid form as stick) may be used; the first application being a light one, in order to test its efficacy, when careful neutralisation with salt water, immediately followed by washing off with fresh water, are most important. After each caustic application the use of iced compresses for an hour is beneficial.

The immediate effect of a caustic application to the conjunctiva is the production of a more or less superficial slough, under which a serous infiltration takes place. This latter increases and finally throws off the slough, and then the epithelium begins to be re-formed. From the time the slough separates until the epithelium has been regenerated a diminution in the secretion may be noted; but the discharge again increases as soon as the regenerative period is ended, and this latter is the moment for a new application of the caustic. From one caustic application of ordinary severity until the end of the regenerative period about twenty-four hours usually elapse.

No corneal complication contraindicates the active treatment of the conjunctiva just described; but, when a corneal ulcer is present, care must be taken that, during eversion of the lids, no pressure is made on the eyeball, lest the floor of the ulcer give way.

Iodoform, finely pulverised, has recently been much praised as a local application in the second stage of acute blennorrhœic conjunctivitis. It is to be dusted freely on the everted conjunctiva once or twice a day. The writer would trust to it in mild cases only.

When only one eye is affected it is important to protect its fellow from infection by means of a hermetic bandage. This may be made by applying to the eye a piece of lint covered with boracic acid ointment, and over this a pad of salicylicated cotton wool. Across this, from forehead to cheek and from nose to temporal region, are laid strips of lint, soaked in collodion, in layers over each other; or a piece of tissue gutta-percha may take the place of the lint and collodion, its margins being fastened to the skin by collodion. The shields invented by Maurel and Buller respectively are very serviceable for this purpose.

The *prophylaxis* of blennorrhœa neonatorum is very important, and should form part of the routine of lying-in practice. Careful disinfection of the vagina before and during birth, and the most minute care in cleansing the face and eyes of the child with a non-irritating disinfectant (e.g. solution of corrosive sublimate, 1 in 1000), immediately after birth, are to be recommended. The antiseptic lotion should be freely poured into the eyes, the lids being held open for the purpose. The method of Dr. Credé has found very general acceptance, and is a good one. It is as follows:—While, after division of the umbilical cord, the child is in the bath, the eyes are carefully washed with water from a separate vessel, the lids being scrupulously freed, by means of medicated wool—absorbent or borated—of blood, slime, or smeary substance; then, before the child is dressed, a few drops of a 2 per cent. solution of nitrate of silver are instilled into the eye.

Treatment of Corneal Complications.—Many surgeons use solution of the sulphate of eserine (gr. iv. ad Aq. f℥j.) dropped into the eye as soon as any corneal complication arises and as long as it continues, because this drug is believed, in addition to its myotic power, to have the effect of reducing the intra-ocular tension (a circumstance to be desired in these instances) and to act, also, as an antiseptic. Its power to reduce the normal intra-ocular tension is not great, and its antiseptic action, if it exists, must be very insignificant, while, on the other hand, in the writer's opinion at least, it has a decided tendency to promote iritis in these cases, where the iris is so liable to become inflamed secondarily to the corneal process. For these reasons the writer does not recommend its use in these cases. His own practice is to employ atropine here, with the object of diminishing the tendency to iritis, by keeping the muscles of the iris and ciliary body at rest. Only if a marginal ulcer should perforate, with prolapse, or danger of prolapse, of the iris into the opening, would eserine seem to be indicated, and then simply for the purpose of mechanically drawing the iris out of, or away from, the perforation by the contraction of its sphincter.

On the first appearance of an infiltration or ulcer of the cornea, besides the use of atropine, nothing can be done further than the steady continuance of the conjunctival treatment, no remission or relaxation of which is indicated. Greater care, however, is required in everting the lids, lest pressure on the globe might cause rupture of the ulcer; and, when a case of acute blennorrhœa of the conjunctiva first presents itself, the surgeon, not knowing the condition of the cornea, must use the utmost caution in making his examination, and yet must never fail to get a view of the cornea for the purposes both of prognosis and of treatment. At each visit the cornea must be examined, and it may be found that, as the conjunctival process subsides, the corneal affection also progresses towards cure, infiltrations becoming absorbed, and ulcers filling up. But, even though the conjunctiva be improving, and still more so if it be not, the corneal process may progress, the infiltration becoming an ulcer, and the ulcer going on towards perforation by becoming gradually deeper. (For the management of the corneal complications see *Suppurative Keratitis, Ulcers, &c.*, under CORNEA, Inflammation of the.)

Central capsular, or pyramidal, cataract may be the result of a small perforating corneal ulcer in blennorrhœa neonatorum. On perforation taking place, the lens, or rather its anterior capsule, comes to be applied to the posterior aspect of the cornea, owing to there being now no anterior chamber, as the aqueous humour has escaped through the opening. The pupillary area is soon filled with fibrinous exudation, the opening in the cornea finally becoming closed, and the iris and lens are pushed back into their places by the aqueous humour, which has again collected. Adherent to the anterior capsule, on the spot which lay against the cornea and which corresponds with the pupillary area, is a morsel of fibrin, which in the course of time becomes absorbed by the aqueous humour. Meanwhile changes have been produced by this exudation on the corresponding intracapsular cells, which result in a small permanent central opacity at that place, where there is also a slight elevation of pyramidal shape over the level of the capsular surface. This is the condition called central capsular cataract, and rarely results from corneal perforation in adults. *See* CATARACT.

It will frequently occur that, on the surgeon's visit to a case of blennorrhœa of the conjunctiva, he will find the margins of the eyelids gummed together by sero-purulent secretion, while the eyelids are bulged out by the pent-up fluid behind them. The attempt to open the eye should then be very carefully made, lest some of the retained pus spurt into the surgeon's eye. The surgeon should also be most careful to thoroughly wash and disinfect his hands and nails immediately after his examination is concluded.

CROUPOUS CONJUNCTIVITIS.—*Causes.*—Contagion. Epidemic.

Symptoms and Diagnosis.—This disease is chiefly found in children, and is not common. The palpebral conjunctiva is a good deal swollen, and is covered with a delicate smooth grey false membrane that may be peeled off, leaving a mucous surface underneath, which then bleeds little, or not at all. The disease is not a severe one, and does not often cause secondary corneal affections. It must not be mistaken for diphtheritic conjunctivitis, from which it is easily distinguished by the readiness with which, in it, the false membrane can be removed, and by the vascular condition of the underlying mucous membrane.

Treatment.—Iced compresses to the eyelids during the croupous stage, with antiseptic cleansing of the conjunctival sac (Sol. hydrarg. perchlor., 1 in 2000, or Sol. acid. borac. 4 per cent). No caustic should be used in this stage, as it is apt to produce corneal changes. Sulphate of quinine sprinkled on the conjunctiva is praised by some surgeons as a useful application in this stage. When the false membrane ceases to be formed a slight blennorrhœa comes on, which may be treated on the principles above laid down.

DIPHTHERITIC CONJUNCTIVITIS.—*Causes.* This disease is very rare in the United Kingdom, but is not infrequent in some parts of Germany. It is difficult to assign a cause for it. It is frequently epidemic, and is extremely infectious.

Symptoms and Diagnosis.—There is no more serious ocular disease than this, for it may destroy the eye in twenty-four hours, while in severe cases treatment is almost powerless.

The subjective symptoms of its initial stage are similar to those of blennorrhœic conjunctivitis, although the pain especially is more severe. The objective symptoms differ from those of blennorrhœa, in that the lids are excessively stiff from plastic infiltration of the subepithelial and deeper layers of the conjunctiva, while the surface of the mucous membrane is smooth, and of a greyish or pale buff colour. The bulbar as well as the palpebral conjunctiva is infiltrated in severe cases. If an attempt be made to peel off some of the superficial exudation, the surface beneath will be found of the same colour, not red and vascular as in croupous conjunctivitis. This stage of infiltration lasts from six to ten days, and constitutes the period of greatest peril to the eye; for, while it lasts, sloughing of the cornea is extremely apt to occur. Towards the close of the first stage the fibrinous infiltration is eliminated from the conjunctiva, which gradually assumes a red and succulent appearance, and secretes a purulent discharge. This constitutes the second or blennorrhœic stage. A third stage is formed by cicatricial alterations in the mucous membrane, which often lead to symblepharon or xerophthalmos; so that, even if the patient escape corneal complications in the first and second stages, other dangers, almost as serious, await him in the final stage. *See* XEROSIS or XEROPHTHALMOS.

Corneal complications (infiltrations, ulcers) are most likely to occur in the first stage, and are then also most likely to prove destructive to the eye. The earlier they appear the more dangerous are they. The corneal complications are more easily managed, if they do not appear until the blennorrhœic stage has commenced, or even if the latter stage come on before an ulcer contracted in the first stage has advanced far.

Treatment.—In the first stage, warm fomentations frequently, with antiseptic cleansing, are the only local measures for the conjunctiva admissible. No caustic or astringent application should be used. Internally the patient should be treated with iron and quinine, and generous diet. In the second, or blennorrhœic, stage, careful caustic applications are to be used. Corneal ulcers must be dealt with, whenever they arise, as though the case were one of blennorrhœic conjunctivitis. When the purulent discharge ceases, solutions of soda, milk, or glycerine may be prescribed as lotions for the conjunctiva, to arrest, if possible, the xerophthalmos.

Phlyctenular Conjunctivitis. — *Causes.*—The strumous constitution—as indicated by the swollen nose and upper lip, and sometimes by the enlarged lymphatic glands in the neck, and by eczema of the eyelids, face, and external ear, and catarrh of the Schneiderian mucous membrane—is that most liable to this affection, the subjects of which are usually children up to the twelfth or thirteenth year of age. Often, however, it will be found in apparently strong children with good general health; but, even in them, there is probably some allied irregularity of nutrition, of which the great tendency to recurrence of the eye-affection is evidence.

Pathology. — This is an eczematous affection, and is characterised by the eruption of vesicles or pustules on the bulbar conjunctiva—so-called phlyctenulæ.

Symptoms.—Two types of the eruption are to be recognised: 1. The solitary, or simple, phlyctenula. Of this there may be one or several, varying in size from 1 mm. to 4 mm. in diameter. Around the phlyctenula is a localised vascular injection, but the general conjunctiva is normal. At first there may be shooting pains in the eye and lacrymation, but these soon pass away. If a phlyctenula be not seated close to the cornea—which might in that case become infiltrated—the affection is not serious. The length of time required for its cure depends on the size of the phlyctenula, varying from seven to fourteen days, as a rule. 2. The multiple, or miliary, phlyctenulæ. These are minute, like grains of fine sand, and are always situated on the limbus of the conjunctiva (i.e. that portion of the bulbar conjunctiva which immediately surrounds the margin of the cornea), which is swollen. The general injection and swelling of the conjunctiva, in this form, is considerable. The lacrymation and photophobia are often very great, and there is a good deal of conjunctival discharge. This form is very apt to appear after measles and scarlatina.

Both forms are liable to extend to the cornea, and then only does the disease become serious. *See* Cornea, Inflammation of the.

Treatment.—The solitary phlyctenula is best treated with the yellow oxide of mercury ointment (Pagenstecher's Ointment: ℞. Hydrarg. perox. præcip. gr. xxx., vaselin ℥j.), of which a bit the size of a hempseed should be put into the eye once a day. Or a small quantity of pure calomel dusted into the eye once a day will also cure. This last remedy should not be used if—as is indeed unlikely—iodide of potassium is being at the same time taken internally, for then iodide of mercury is liable to be formed in the conjunctiva.

The miliary phlyctenular conjunctivitis at its outset should be treated with cold or iced applications; or, at most, some freshly-prepared solution of Liq. chlori (1 part Liq. chlori, 9 parts water), may be dropped into the eye. Later on Liq. plumb. dil. or Sol. arg. nitr. (gr. v. ad Aquæ f℥j. and neutralised), applied to the everted conjunctiva, are suitable; or, if the phlyctenular appearances predominate over the catarrhal, the yellow oxide of mercury ointment, or insufflations of calomel, may be preferred. When the cornea is slightly affected near the margin, in cases of miliary phlyctenulæ, calomel, or the yellow oxide of mercury ointment, and warm fomentations should be used.

The after-treatment of phlyctenular conjunctivitis is important, in order to prevent recurrence of the affection. It consists in the insufflation of a minute quantity of calomel into the eye once a day, until, on awaking in the morning, the eye is found to be quite free from vascular injection. This after-treatment may require to be continued for three or four weeks.

Conjunctival Complication of Small-pox.—A good deal of uncertainty has prevailed with regard to this affection, as the initial stages were not observed by physicians owing to swelling of the eyelids, while the ophthalmologist saw only the results of the process in the period of convalescence from the general disease, or later. The following embodies the view of Professor Horner, who made a special study of this matter throughout a severe epidemic of smallpox.

Smallpox pustules on the cornea are extremely rare. Horner saw but one case. The most frequent and most serious mode of attack consists in a greyish-yellow infiltration of the conjunctiva close to the lower margin of the cornea, not extending to the fornix conjunctivæ, nor far along the inner or outer margin of the cornea. It occurs in the eruptive stage, and is to be regarded as a variolous pustule. This infiltration or pustule gives rise to a corneal affection, either in the form of a marginal ulcer, or as a deep purulent infiltration, ulcerating, perforating, leading to staphyloma, purulent irido-choroiditis and panophthalmitis, results which are often first observed long after the primary conjunctival affection has disappeared. The germ of the conjunctival affection probably makes its way between the eyelids. This theory would account for the constancy of the position of the primary affection—that part of the conjunctiva, with closed eyelids and eyeball consequently rotated upwards, being the most exposed to particles entering.

Treatment.—On this ground the prophylactic use of boracic acid ointment on lint applied over the eyelids is to be recommended. If a conjunctival pustule has already formed without any, or with only commencing, corneal affection, Horner advises the destruction of the pustule with fresh Liq. chlori, or with mitigated lapis (Arg. nitr. 1 part, Potassæ nitr. 2 parts, in the solid form as stick), carefully neutralised with solution of common salt after application. Corneal complications are treated as in blennorrhœa or diphtheritis of the conjunctiva.

The frequency with which the eyes become affected varies in different epidemics of smallpox.

AMYLOID DEGENERATION OF THE CONJUNCTIVA.—*Cause.*—This rare disease is not associated with amyloid disease in any other part of the system. It seems sometimes to be developed from granular ophthalmia, but occurs also as a primary disease.

Symptoms and Diagnosis.—The affected eyelid is much swollen, but there is a complete absence of all inflammatory symptoms. The patient can but partially elevate his lid, which is so stiff and hard that it is everted only with difficulty by the surgeon. The conjunctiva has the appearance of white wax. The positive diagnosis may be made by submitting a small portion (removed) of the diseased conjunctiva to the iodine test.

The disease attacks chiefly the palpebral conjunctiva, but is also seen in the bulbar portion. It ultimately extends to the cartilage and is a strictly local disease, unassociated with amyloid degeneration in other parts of the system.

Treatment.—When feasible, removal of the diseased parts by the knife and scraping is the only measure possible.

TUBERCULAR DISEASE OF THE CONJUNCTIVA.—This is an extremely rare disease. It commences in the bulbar or palpebral conjunctiva as small, pale, yellowish nodules, which soon ulcerate. The ulcers are apt to extend very widely, in one case the whole of the bulbar conjunctiva and part of the palpebral conjunctiva having become involved. The margins of the ulcers are irregular but well-defined, and their floors covered with a pale yellowish creamy deposit. The surrounding conjunctiva is swollen, and, if the palpebral conjunctiva be much involved, the lid becomes enlarged in every dimension.

Symptoms.—There is often no pain, or only a slight burning sensation; but, again, when the ulceration is extensive, very severe pain may come on.

Diagnosis.—Secondary syphilitic disease is that most apt to simulate the appearances of tubercular disease in the conjunctiva. The absence of a syphilitic taint, the presence of tubercular disease elsewhere in the system, or the existence of well-marked family tuberculosis would all point to the disease being of tubercular nature; but the most certain method of diagnosis will lie in the microscopic examination of morsels removed from the nodules or ulcers, and, above all, in inoculation experiments made with such morsels.

Treatment.—Tonics, especially cod-liver oil, are indicated. But inasmuch as the disease is apt to spread to other tissues of the eye (cornea, sclerotic, iris, choroid), the destiny of these eyeballs is, probably in most cases, enucleation. H. R. SWANZY.

CONJUNCTIVA, Injuries of the.—Foreign bodies frequently make their way into the conjunctival sac and cause much pain, especially if they get under the upper lid, by reason, chiefly, of their coming in contact with the corneal surface during motions of the lid and of the eye.

If the foreign body be under the lower lid it is found by drawing the lid down, and, provided it be not actually embedded in the tissue, it is readily removed with a camel's-hair pencil, or with the corner of a soft handkerchief. But if the foreign body be under the upper lid, it is necessary to evert the latter before it can be reached, Should the foreign body be embedded in the conjunctiva it will require to be removed with a needle suitable for the purpose; and the little proceeding will be made easier, both for patient and surgeon, by the instillation of a few drops of solution of cocaine (two per cent.) into the eye.

The conjunctiva is frequently implicated in severe injuries of the eyelids or eyeball; but the consideration of these cases does not come within the scope of this article. The most common form of injury, which may involve the conjunctiva only, is a burn, by fire, acid, or lime.

In the case of a strong acid getting into the eye, if the patient be seen soon after the occurrence, the whole conjunctival sac should be well washed out with an alkaline solution; while, in the case of lime, a solution of a weak mineral acid is indicated for the purpose. Cocaine may be employed to relieve the pain. Subsequently, protection of the eye, with the use of olive or castor oil dropped into it, will best promote the healing process.

In the case of a severe burn of the conjunctiva the resulting cicatrix is liable to produce a more or less extensive union of the eyelid to the eyeball (symblepharon), which often interferes with the motions of the latter, or even with vision if the cornea be obscured. No measures taken during the healing process can prevent symblepharon if the degree of the burn be such as to bring it about.

In many cases it becomes desirable to relieve the symblepharon by operation. The mere dissection of the lid from the eyeball, with the interposition between the two of morsels of oiled lint, &c., proves futile in these cases. It is always necessary to cover one or other of the resulting wounded surfaces with a layer of mucous membrane, in order to prevent recurrence of the condition. This can be effected in some cases by transplantation of conjunctival flaps with pedicle from a healthy portion of the eyeball, according to the proceeding of Teale (*Ophthal. Hosp. Rep.* vol. iii.), or of Knapp (*Archiv für Ophthalmologie*, vol. xiv. pt. 1). A more universally applicable method is the transplantation of conjunctival flaps without pedicle from another patient on the occasion of enucleation of an eyeball, or from a rabbit's eye, or of a portion of mucous membrane from the lips, or from the vagina (Stellwag). The chief precautions necessary for success in this proceeding are:—That the flap to be transplanted be not applied in its position until all bleeding in the latter place has ceased; that the flap be nothing more than mucous membrane, all submucous tissue being carefully removed; that it be sufficiently large to cover the surface without stretching (and it is to be remembered that the flap shrinks to two-thirds of its size after being detached from its own bed); that the flap be kept moist and warm during the period, as short as possible, which elapses between its detachment and its adjustment; and, finally, that it be kept firmly in its new position by a sufficient number of points of interrupted suture. H. R. Swanzy.

CONTRE-COUP. *See* Head-Injuries, Diagnosis of.

CONTUSIONS. *See* Bruises.

COPAIBA-RASH.—Copaiba not only causes disturbances in the digestive canal, but may, as it is eliminated in the breath and perspiration, give rise to certain slight affections of the respiratory and cutaneous surfaces. The skin affection consists, in most instances, in a bright red roseolar eruption, which is to be found chiefly on the back of the neck and arms, and on the chest. This eruption, which usually causes much itching, appears very soon after the first dose of copaiba has been taken, but often persists for several days after the administration of the balsam has been discontinued. It is never the cause of any marked febrile disturbance. The so-called copaiba-rash of which this is the most frequent form seems to be due to the irritating action of this remedy on a skin that is predisposed to become affected with some form or other of eruption. In some cases the rash is a well-marked and painful urticaria, in others it is decidedly papular, and in others, again, it consists of small dusky patches.

CORACOID PROCESS, Fracture of the.—This process may be broken through at any part between its tip and its base. The injury which, however, is extremely rare, is caused only by great direct violence, as when a wheel passes over the shoulder. It is often combined with other lesions, e.g. dislocation or fracture of the upper end of the humerus, or of the clavicle. When the fracture is beyond the coraco-clavicular ligaments the fragment is drawn down by the muscles connected with it; but when the process is broken at its base the ligaments prevent any marked displacement, and the only symptoms are mobility, crepitus, and pain; but these are often obscured by swelling, or by other lesions that are present.

The *treatment* consists in supporting the elbow, brought forward across the chest, in a sling, so as to keep the muscles at rest. HOWARD MARSH.

CORNEA, Examination of the.—Anatomically, the cornea is usually regarded as consisting of five layers, namely, the epithelium; the anterior elastic layer (Reichert's or Bowman's); the fibro-cellular substance, or *substantia propria*; the posterior elastic membrane (Demours' or Descemet's); and the endothelium. Embryologically, however, there are only three layers, namely, (1) the epithelium and anterior elastic membrane; (2) the proper substance; and (3) the posterior elastic membrane with its endothelium. Each of these embryonic layers has a peculiar mode of development, and there are significant differences in their origin. The anterior layer is derived from the external layer of the blastoderm or epiblast, and is continuous with the epidermis of the external integument, while the middle and posterior layers are derivatives of the mesoblast, and are therefore related to all the fibro-vascular structures of the body, including bones, muscles, blood-vessels, and cutis. This relationship extends not only to the mode of development and the nutrition, but also to pathological changes of these several systems. Lesions of the epithelial layer of the cornea resemble those of the epidermis and superficial layer of the dermis, and are associated with them; lesions of the proper substance are associated with those of the fibro-vascular structures of the body; while lesions of the posterior layer are often associated with toxæmic states in which the serous or synovial membranes are implicated. As concrete examples we may take the association of phlyctenular keratitis with eczema in strumous persons, interstitial keratitis with manifestations of hereditary syphilis, keratitis punctata with gonorrhœal rheumatism.

The cornea is nourished partly by blood and partly by lymph. The blood-vessels are derived from branches of the anterior ciliary arteries, and are, in health, found only at the peripheral portion of the anterior surface, where they form delicate loops near the corneal margin, and anastomose with the vessels of the conjunctiva. The posterior layer and the proper substance of the cornea are nourished by the aqueous humour, which gains access to them through the lymphatic spaces of Fontana, and through the stomata in the endothelium. Consequently, the integrity of these layers depends, more or less directly, upon a healthy state of the ciliary body and iris, by which the aqueous humour is secreted. *See* CILIARY BODY; IRIS.

The cornea is innervated by branches of the ciliary and conjunctival nerves. The greater number of the nerve-branches enter the deeper layers of the cornea, and lose their myelin sheaths. They then form plexuses in the stroma, from which fine branches pass forwards to penetrate the anterior elastic membrane. Here they are arranged in a fine sub-epithelial plexus, from which fibrillæ are given off to end between the epithelial cells as free terminals or in corpuscles.

Pathology.—In the economy of the eye and vision the cornea has at least three separate functions to perform. First, by its texture and general construction it fills in and supports the anterior segment of the globe. Second, by its transparency it permits the admission of light within the eye. Third, by its curvature it so refracts this light that, after passing through the dioptric media, it is brought to a focus upon the retina. Alterations of any one or more of these functions constitute disease. Alterations in nutrition of the cornea may affect either its texture, or its translucency, or its curvature. The cornea may also be the site of neoplasmata of an epithelioid or of a sarcomatous nature; but these are rare.

Physical Examination.—In examining the cornea it is necessary, not only to search the surface, but also the substance and the posterior layer. Attention should also be given to the adjacent structures, more particularly the circumcorneal blood-vessels, the anterior chamber, and the iris. This can best be done by adopting a definite plan of inspecting by direct light, by oblique illumination, by the ophthalmoscopic mirror, and by palpation.

1. Examination of the cornea by direct light is most conveniently done by placing the patient opposite a window, so as to obtain a reflection of the window on the cornea. If the eye be made to follow the observer's finger, moving in various directions of the visual field, it is easy to observe whether the polish and lustre of the surface is disturbed or not. If the surface be intact the image will be unbroken in every position; but if it be uneven, whether from cicatrisation, ulceration, or the pre-

sence of a foreign body, the reflection is broken.

2. In oblique or focal illumination, the patient is placed by the side of a lamp, while the light is concentrated on the cornea by a convex lens of about three-inch focal length. By this means, not only the surface, but the substance and deeper layers of the cornea may be thoroughly examined for opacities, foreign bodies, or breaches of continuity.

3. Transmission of light into the eye by means of the ophthalmoscopic mirror not only discloses the presence of opacities, but is often the only means of discovering irregularities of conical cornea, semi-transparent facets, or fine nebulæ.

4. Palpation is less applicable to the cornea than to some other organs, but it may assist diagnosis, either by eliciting alterations of tension or of sensibility. In health the cornea is exquisitely sensitive to touch, but in some neuropathic states it may be hyperæsthetic or anæsthetic in isolated portions, or throughout its whole extent. John Tweedy.

CORNEA, Inflammation of the.—Keratitis or Corneitis.—The phenomena that follow the impaction of a foreign body on the cornea are well known. At first, there is sudden smarting, spasmodic closure of the lids, profuse lacrymation, and redness of the conjunctiva. If the particle be not removed, the manifestations soon undergo some change. The smarting pain is displaced by a dull aching throb above the eyebrow and down the side of the nose, and the sight is dimmed. Coincidently, for some distance around the foreign body the cornea becomes hazy, and a well-defined zone of congested blood-vessels appears around the margin. Still later—especially if the injury be very severe, and the foreign body possess infective properties—the haziness may increase in extent and in intensity; the surface of the cornea ulcerates, pus infiltrates the laminæ and invades the anterior chamber. Eventually perforation may occur, followed by prolapse of the iris and probable destruction of the globe. Inflammation of the cornea may, however, be induced by injury and yet the subsequent course be different, the series of tissue changes culminating in one or other of the forms of keratitis described below; or inflammation may begin without any appreciable injury. The subjective symptoms vary greatly in the different forms of keratitis. There is always more or less pain, together with impairment of sight. Speaking generally, it may be said that inflammation of the anterior layer is more painful than inflammation of the middle and posterior layers; whereas the impairment of sight is usually greater in inflammation of the middle and posterior layers than of the anterior layer.

Pathology.—In all forms of keratitis, whether the inflammation affect the superficial or the deeper layers, there is an appreciable alteration of texture, consisting of an increase in the number of cellular elements and an accumulation of fluid. The canaliculi of the cornea are distended with fluid and with cells. The precise origin of these cells has not been definitively determined. According to Cohnheim and his disciples, all are derived, by a process of diapedesis, from the adjacent blood-vessels, and are in no degree due to the proliferation of the fixed corpuscles, as formerly believed, and as Böttcher still maintains. Experimental evidence goes to show that, in the earlier stages of keratitis, the cells which first congregate are entirely migratory, inasmuch as they are met with before the fixed corpuscles have had time to multiply. Indeed, the advocates of the migratory theory allege that the fixed corpuscles do not proliferate at all, so long as inflammation continues. Whatever change they may undergo is of a retrogressive character. Stricker, Norris, Fuchs, and others believe that the cellular elements of inflammation are derived from both sources. The truth may be that the nature and degree of the inflammation determine what share the blood-vessels and what the tissue-elements shall take in furnishing new cells. If the inflammation be slight, the fixed corpuscles may supply some of the cells; but, if it be severe, these ciliary and conjunctival blood-vessels are probably the sole contributors.

The disposition which the cell-infiltration assumes differs in the different layers of the cornea. When the epithelial layer is affected, the leucocytes are commonly collected into isolated masses, which are called 'phlyctenules' or 'pustules.' When the middle layer is affected the infiltration is more diffused. When the posterior layers are affected the inflammatory product consists mainly of a serous effusion into the anterior chamber, and of deposit of lymph and leucocytes upon the endothelium, corresponding exactly with the changes that occur in, say, serous pleuritis. When the inflammation affects the proper substance, the new cells and the fluid are at first confined to pre-existing channels; but later, the fibrillæ are destroyed, partly by softening and pressure, and partly by the corroding action of the leucocytes. As soon as the fibrillæ are broken the cells wander through the disintegrated cornea, or collect into a circumscribed cavity to form an 'abscess.' If the softening and disintegration lead to an opening on the external surface, the lesion is called an 'ulcer'; if to an opening through the posterior layer, with escape of pus into the anterior chamber, it is called 'hypopyon.'

Repair.—The amount and character of repair which takes place in the cornea depend upon the degree of inflammation. If only the epithelium have been implicated, it is reproduced without leaving any scar, but if any portion of the anterior elastic membrane or the fibrous substance have been destroyed, a cicatrix will always remain to record the fact. When, however, the inflammation of the cornea has been slight, the exuded fluid and cells are absorbed, while the fixed corpuscles assume great nutritive and formative activity, and finally restore the tissues to their former state of integrity; if more severe, many of the fixed corpuscles will have perished, and the leucocytes must participate in the reparative process, and then restoration is not so perfect. If an appreciable portion of tissue have been destroyed, the loss is made up almost entirely by migration cells, new blood-vessels being developed to supply the nutrient material. This process is known as 'granulation' and 'cicatrisation.' By it perfect restoration to the normal state never takes place, the site being ever afterwards indicated by an opacity, which consists of scar-tissue. As the reparative process approaches completion, the new vessels gradually shrink, and ultimately disappear. See *Opacities of the Cornea*, under CORNEA, Ulceration of the.

Causes.—The causes of keratitis are twofold, namely, predisposing and exciting.

The *predisposing* causes may be (*a*) general, or (*b*) local.

The chief general predisposing causes are—age, diathesis, occupation. *Phlyctenular keratitis* (q.v.) occurs most frequently between the ages of three and fifteen years; *interstitial keratitis* (q.v.) between eight years and twenty; whereas *keratitis punctata* (q.v.) is most frequent between the ages of seventeen and thirty. Diathesis plays an important part in keratitis. Scrofula and syphilis each notoriously determines a peculiar form of keratitis, and there is reason to believe that the arthritic diathesis, gonorrhœa, and toxæmic states may be the predisposing conditions of inflammation of the lining membrane of the anterior chamber—keratitis punctata.

Among the local predisposing causes are acute or chronic congestions or inflammations of the conjunctiva; impaired innervation of the eyeball, either from disease of the fifth nerve, or from disorders of the sympathetic, or from dental irritation, or from a tumour encroaching upon the medulla oblongata. Morbid states of associated and correlated tissues may also predispose to keratitis. In inflammation of the ciliary body, for example, the quality of the aqueous humour is altered, and the nutrition of the cornea is, in consequence, prejudicially affected, and the resistance of the tissue thereby diminished. The vascular engorgement of the front portions of the eyeball, which is associated with uncorrected or miscorrected errors of refraction, may render the cornea susceptible to inflammation from slight exciting causes.

The *exciting* causes are, however, the factors that initiate the characteristic pathological phenomena. These agents are always of the nature of 'irritants,' whether material, chemical, thermal, or organic. Foreign bodies, acids, alkalies, sparks, or infective fluids and particles, such as may occur in purulent conjunctivitis or in the accumulated contents of an obstructed lacrymal sac, or other septic fluids, are the most common exciting causes of keratitis.

Treatment.—The objects to be aimed at are: (1) to relieve pain; (2) to arrest the progress of the inflammation; (3) to promote early and rapid resolution; (4) to prevent complications; and (5), if possible, to obviate recurrence.

Happily, those measures which are calculated to attain any one of these ends may be trusted to reach the others. In all cases the indications suggested by a survey of the various predisposing and exciting causes should be carefully followed. In the beginning of the treatment, not only must actual extraneous substances be removed, but precautions must be taken to protect, as far as practicable, the eyes from irritating influences of every kind. Rest of the eyes is always desirable and often obligatory.

It cannot be too strongly insisted upon that, in the early stages at all events, the treatment must be of a soothing and sedative character. Stimulating applications are contra-indicated until resolution is well advanced, and are then only justifiable if the reparative process seems to flag.

One of the most convenient and efficient remedies for the relief of pain, and for favourably affecting the inflammatory process, is moist warmth, either in the form of vapour or fomentations, simple or medicated. Of the medicated applications, decoction of poppies, or a solution of extract of belladonna (gr. iv.–viij. ad f℥j.), is the most accessible and the best. These should be used every two, three, or four hours, according to the severity of the pain. In the intervals the lids should be kept tied up with a light compress saturated in the fomentation, except when there is much conjunctival or lacrymal secretion. Permanent compresses are unsuited to cases in which there is much secretion.

In addition to these external applications, a solution of atropine (gr. ij.–iv. ad f℥j.), should be dropped inside the lids two or three times a day, or oftener, according to circumstances. The benefits of atropine are manifold. It is anodyne, mydriatic, and antiphlogistic. It has an additional use in putting the muscular tissue of the iris, ciliary body, and choroid at rest. Solutions of eserine or pilocarpine (gr. j.–iv. ad f℥j.) are preferred by many practitioners for superficial corneal ulcerations. According to the writer's experience it is not suitable in the earliest stages; and at any time it is, perhaps, most serviceable when the inflammation is marginal. Eserine, or other myotic, is especially indicated whenever the tension of the eyeball is increased, provided there be no iritis.

If the pain be severe, and more particularly if it be supraorbital, the application of one or two leeches to the inner angle of the orbit or over the malar bone, followed by hot fomentations, will seldom fail to give relief. Local depletion answers best in the early or vascular stages of the inflammation, or at the beginning of exacerbations of an existing inflammation.

As the cornea is always liable to be infected by morbid secretions of the conjunctival or the lacrymal sac, cleanliness and drainage should be ensured. Secretions should not be allowed to collect, and those that are present should, as far as practicable, be rendered innocuous. Antiseptic preparations of some kind may be needed; but care must be exercised in their selection. For instance, solutions of carbolic acid are too irritating, and solutions of permanganate of potash are equally inapplicable on account of their solvent action on the corneal cement. The safest and best preparations are solutions of boracic acid (gr. iij.–viij. ad f℥j.), sulpho-carbolate of soda (gr. v.–x. ad f℥j.), perchloride of mercury (gr. $\frac{1}{16}$–$\frac{1}{10}$ ad f℥j.), sulphate of quinine (gr. iv. ad f℥j.), and iodoform ointment (gr. iij.–x. ad ℥j.).

While it is indisputable that, both for the relief of pain and for completeness of the ultimate recovery, the treatment of keratitis must be pre-eminently local, internal remedies are not to be despised. The drugs most likely to ease pain are croton-chloral hydrate, in three-grain doses every half-hour, with or without small doses of gelsemin; juice of conium, in one-drachm doses every two to four hours; opium, either as compound soap pill or compound ipecacuanha powder. Mild aperients and alteratives are useful adjuvants. A mercurial purge at the beginning of keratitis, especially when this is due to injury, often gives distinct relief, and favours the action of the local remedies. In the diathetic inflammations, appropriate constitutional treatment is of course required. It is, however, well not to be too precipitate in adopting 'a tonic plan of treatment.' This caution applies especially to the employment of ferruginous preparations. Iron almost invariably does harm in the irritation-stage of keratitis, although it may otherwise seem to be indicated by anæmia and general debility.

After the acute symptoms have subsided, and reaction is advanced, the process of repair may often be expedited by the occasional application of mild stimulants, such as the yellow oxide of mercury ointment (gr. iij.–xv. ad ℥j.), powdered calomel, and weak perchloride of mercury lotion. Still later, when cicatrisation has begun, these applications may be advantageously combined with light frictions of the lids over the cornea. Friction (massage) systematically employed certainly promotes the absorption of the inflammatory products, and thereby minimises the subsequent opacity.

Counter-irritation by means of a blister behind the ear, or still better over the temple or forehead, is often beneficial in chronic keratitis; but in acute keratitis its value is, to say the least, equivocal. The same remark applies to setons.

If haziness or opacity remain about the centre of the cornea while the margin becomes clear, an artificial pupil may be made opposite the clear cornea. *See* Iris, Diseases of the; Iridectomy.

Finally, it should be remembered that when once a cornea has been inflamed it is liable to recurrences on slight provocation. Hence, the importance of abstaining from close application of the eyes until repair has had time to become thoroughly established, and for some time after.

Forms of Keratitis.—Inflammation of the cornea has been variously classified. Sometimes the classification is based on the character of the inflammation or the stage of the inflammatory process, or its results, as exudative, infiltrative, suppurative, or ulcerative; sometimes on the appearance of the cornea, whether it be vascular or not; sometimes on the constitutional condition with which the inflammation is associated, as struma, syphilis, rheumatism, &c. In this article it is proposed to classify them according to the relations and affinities disclosed by the study of the embryology and physiology of the cornea. Keratitis may therefore be considered according as it affects—(1) The anterior layer; (2) the proper substance; and (3) the posterior layer.

As, however, the phase of the inflammation has important clinical bearings, it is convenient to consider keratitis in its three principal modes of—I. Infiltration; II. Suppuration; III. Ulceration.

I. Infiltration-keratitis may, in accordance with the above-named principle, be classified as it affects—

1. The anterior layer: (*a*) traumatic; (*b*) trachomatous; (*c*) phlyctenular; (*d*) neuropathic, including herpes of the cornea.

2. The proper substance: (*a*) circumscribed, interstitial, or parenchymatous; and (*b*) diffuse interstitial keratitis.

3. The posterior layer: Keratitis punctata, vel Aquo-capsulitis, vel Iritis serosa.

II. Suppuration or abscess due to (*a*) phlyctenular, purulent, or diphtheritic conjunctivitis; (*b*) variolous or neuropathic keratitis.

III. Ulceration which may be (1) inflammatory or (2) non-inflammatory (neuropathic), each of which may affect the superficial or the deeper layers.

(1) Inflammatory ulcers:

(*a*) Superficial, simple, and irritable, or vascular; (*b*) deep, suppurative, and infective.

(2) Non-inflammatory (neuropathic):

(*a*) Circumscribed, superficial, deep, and crescentic; (*b*) diffuse, or necrotic.

I. INFILTRATION-KERATITIS.

1. INFLAMMATION OF THE ANTERIOR LAYER, viz. the epithelium and elastic membrane.

(*a*) *Traumatic Keratitis.* See *Keratitis* above, and Cornea, Injuries of the.

(*b*) *Trachomatous Keratitis or Pannus.* In trachoma, or true granular lids, in addition to the presence of the characteristic growths in the tarsal portions of the conjunctiva, there is a peculiar affection of the cornea and adjacent conjunctiva called 'pannus.' This consists of infiltration, thickening, and vascularisation of the anterior layers, especially at the upper half or two-thirds. These changes are due partly to the mechanical irritation of the roughened lids, and partly to the infiltration. There is no necessary proportion between the amount of trachoma and the degree of pannus. On the one hand, there may be great roughness of the lids, with but slight pannus; and, on the other hand, the pannus may be extreme, but the affection of the lids slight. Indeed, in some cases, the pannus is an early phenomenon, and is fully established, while the trachomata are still confined to the subepithelial layer of the mucous membrane. In such cases, therefore, the corneal affection would seem to be the result of inoculation rather than of friction.

The amount of thickness and opacity varies: when slight, it is called *pannus tenuis*; if thicker, *pannus crassus*, and if very thick and fleshlike, *pannus sarcomatosus*. Except in very chronic cases only the upper half or two-thirds is hazy and vascular, while the lower portion may be unaltered, so that the sight may continue acute, though weak. In severe cases, the swelling, opacity, and vascularity are so great as to give to the cornea the appearance of fleshy granulations, and may implicate its whole extent. A rich network of blood-vessels extends on to the cornea from the conjunctiva and episcleral capsule over the surface. Under these circumstances the subjective symptoms are more marked. Lacrymation, photophobia, and supraorbital pain are present in proportion to the degree of corneal implication. In those instances where ulceration or suppuration of the cornea occurs, these symptoms are very severe.

The infiltration takes place between the epithelium and the anterior elastic layer, and may lead to thinning of this layer and its ultimate destruction. Pannus may be complicated by ulceration of the cornea and perforation, or the inflammation may extend to the deeper structures, and set up iritis, and even panophthalmitis. But short of this retrogressive changes of the cornea may take place, leading to bulging of the cornea and staphlyloma, or the whole of the cornea may become opaque from cicatrisation, followed by flattening and atrophy. In rare cases the pannus undergoes progressive hypertrophy, so as to form permanent growths, which may be mistaken for actual tumours. Glaucoma is a not unfrequent late complication of eyes damaged by trachomatous keratitis.

Diagnosis is usually easy. The keratitis is at first limited to the upper part of the cornea, and an eversion of the upper lid discovers the presence of trachomata. There is, in addition, slight ptosis, with some thickening and incurvation of the upper lid.

Treatment must be chiefly directed to the trachomatous conjunctivitis, though the cornea itself may require special attention. It may, however, be pointed out that corneal implication is not a contra-indication for the active treatment of the trachomatous state of the conjunctiva. On the contrary, it usually denotes that more vigorous measures are needed. For the details of the various modes of treating pannus, see *Trachomatous Keratitis.*

(*c*) *Phlyctenular Keratitis*—This is the most frequent of all the forms of inflammation of the cornea. It is characterised by the presence of one or more minute vesicles, or vesiculo-pustules, situated on the surface of the cornea, or at the corneal margin. When the phlycten is in the cornea, there is always more or less injection of the conjunctival or epithelial vessels; but when at the margin the congestion is limited and patchy, and generally disposed triangularly with the apex towards the phlyctenule and the base towards the conjunctival *cul-de-sac*. The epithelium is rapidly shed, giving rise to a superficial ulcer, which, as a rule, soon heals. Associated with the phlyctenulæ on the cornea there is generally eczema with abortive vesicles on the lids, about the anterior nares, lips, and ears. The subjective symptoms are lacrymation, photophobia, and spasmodic closure of the lids—blepharospasm.

There are three other clinical forms, namely, (1) the miliary, (2) the pustular, and (3) the diffused.

In the miliary form the phlyctenulæ are not discrete, but are scattered around the entire circumference of the cornea. There is more circumcorneal injection; indeed, the general redness of the front of the eyeball resembles that of catarrhal conjunctivitis.

In the pustular form the phlyctenulæ are larger, and usually form around the corneal margin. Necrosis often takes place, resulting in a deep ulcer, which creeps over the cornea, eating its way into its substance, down to the posterior elastic membrane.

In the diffused form phlyctenulæ occur from time to time on the surface of the cornea, leading to general haziness and a vascular condition resembling trachomatous pannus. The anterior elastic membrane is always more or less involved, so that repair is always attended with more or less cicatrisation, though often the scar is not enough to permanently interfere with vision. When repair is retarded the ulcer resulting from the ruptured phlyctenule may become vascular, and partake of the characters of the ordinary irritable ulcer. See *Superficial Vascular Ulcer*, under CORNEA, Ulceration of the. Owing to depraved states of health, the inflammation may be of a low type, and go on to suppuration of the parenchyma and the formation of abscess, followed by ulceration and perforation.

Phlyctenular keratitis is prone to return, and recurrences may be induced by slight causes, as errors of diet, temporary illness, close work, foreign bodies, &c.

Pathology.—The essential anatomical condition of a vesicle in the skin is stratified epidermis. This fact explains the site and distribution of corneal phlyctenulæ. These only occur on, or near, the cornea, and it is noteworthy that only on the cornea and adjacent portions of the conjunctiva the epithelium is stratified. In the rest of the conjunctiva the epithelium is columnar, in which neither vesicles nor pustules form. There are pathological and clinical reasons for believing that a phlyctenula always occurs at a nerve-terminal; this accounts for the photophobia which seems to depend upon the exposure of nerve-terminals.

Causes.—The disease is usually one of childhood, being most common between the ages of two and fifteen years, and it is generally associated with a scrofulous or lymphatic habit of the body, in which cutaneous disorders of an eczematous type are common. It may be provoked by any depraved condition of health, and is set up by an attack of measles, scarlet fever, or whooping cough. In subjects otherwise predisposed, the disease may be early induced by irritants of every kind—wind, dust, foreign bodies, conjunctivitis, &c., and in some cases it seems to be due to reflex irritation, both dental and gastro-intestinal.

Treatment varies somewhat according to the stage. Locally, in the acute stages, warm applications, moist or dry, simple or medicated, with mild antiseptic and detergent lotions, especially when there is eczema of the lids, with copious lacrymation. In the later stages, when vascularity is established, mild irritants are beneficial. When there is reason to suspect septic influences are at work, either the perchloride of mercury lotion, quinine lotion, or chlorine water should be used; for photophobia, cold douches, chloroform vapour, alkaline lotions containing hydrocyanic acid. Blepharospasm usually subsides as the state of the cornea improves, but sometimes it also is perpetuated by fissures at the outer canthus. These may be relieved by forcible separation of the lids, so as to tear the fissure, or by a division of the canthus. In the pustular form, when ulceration begins, eserine is useful to diminish tension, and thereby lessen the risks of perforation. But, if in spite of this, perforation becomes imminent, then the base of the ulcer should be incised, and the aqueous allowed to escape. The eczematous condition of the lids, &c., require appropriate treatment. *See* ECZEMA. There is almost always at the beginning much constitutional disturbance; alteratives and mild aperients are then useful, as small doses of mercury and chalk powder, with belladonna or compound rhubarb powder, magnesia, &c. In acute cases, where the photophobia is very distressing, nauseating doses of antimonial wine give quick relief to the more urgent symptoms. When the irritative symptoms have subsided, tonics may be employed, as quinine, iron, cod-liver oil, arsenic, phosphorus, hypo-phosphites, &c.

(*d*) *Neuropathic Keratitis.*—It is well known that in injury and other irritative affections of the cutaneous nerves, inflammation and ulceration of the skin supplied by these nerves are not uncommon. Erythema, urticaria, herpes, pemphigus, and eczema are the commonest forms which these nutrition-changes in the skin assume. They are characterised by suddenness of onset, and by a tendency, either spontaneous or easily induced, to suppurate and ulcerate. In some cases the ulceration is so rapid and so extensive that it amounts to necrosis of a material portion of the skin. An illustration of this is seen in the sacral eschars which occur in some acute diseases of the brain and spinal cord. Similar lesions may take place in the cornea in irritative disorders of the fifth nerve and its ganglion. Magendie first showed that division of the fifth nerve may be followed by inflammation of the cornea, with exudation into the interior of the globe. The experiment has been repeated and varied by many subsequent observers with similar results. Clinical experience harmonises with the facts of experimental physiology. The investigations of Bärensprung and others have shown that herpes zoster is associated with irritative change in an intercostal nerve and its ganglion; and in 1866 Mr. Jonathan Hutchinson recorded several cases of frontal herpes in which there was inflammation of the conjunctiva, cornea, or iris of the corresponding eye. In some of the cases the inflammation was so great that the eyes were lost (*Ophth. Hosp. Rep.*, vol. v. 191).

Whatever may be the alteration in the nerve and its ganglion which gives rise to the changes in the cornea, it is almost certain that it is of an irritative rather than of a paralytic character. It is difficult to map out the chief clinical forms of neuropathic keratitis, because they are all prone to run on to suppuration and ulceration. Indeed, with the exception of herpes of the cornea, it may be said that neuropathic keratitis is almost invariably ulcerative. In the writer's opinion there is reason to believe that inflammation of the cornea dependent on neuropathic causes is much more frequent than is commonly supposed. It is usual to recognise as neuropathic only those forms of keratitis that are associated with other and obvious affections of the fifth nerve, such as herpes of the brow and nose, together with anæsthesia of these parts and the cornea. On the other hand, it is probable that many cases occur in practice in which the affection of the eyeball is the *only obvious* evidence of altered innervation. At all events, it is certain that cases are by no means infrequent in which the inflammation of the cornea behaves exactly like unquestionable neuropathic keratitis, and which is amenable only to the kind of treatment that best suits the genuine form.

The state of sensitivity of the cornea does, however, seem to influence the kind of change which takes place and the rate of progress. If the cornea be anæsthetic, suppuration and ulceration often take place with extreme rapidity, though without any subjective symptoms beyond the loss of vision. Within a few days of the first appearance of noticeable symptoms the cornea may be completely destroyed. In less severe cases the cornea becomes dull and sodden-looking on its surface, the substance is more or less infiltrated, and there is, perhaps, a small collection of pus in the anterior chamber. If the necrotic process continue, all these signs increase, and the cornea may at length give way. When the cornea is not insensitive the rate of progress is slower, but the pain, photophobia, and other subjective symptoms are greater. In this form the signs of inflammation are also more conspicuous, as redness, watering, and swelling of the lids and conjunctiva. In some cases it would almost seem as if the ordinary pain of ulceration of the cornea had superadded to it the exaggerated, but perverted, sensibility of the diseased nerve.

In some instances the corneal change is more circumscribed, and may simulate simple phlyctenular keratitis. A minute, very superficial, abscess forms, which quickly opens externally to form an ulcer: but, instead of healing, the ulcer becomes more and more infiltrated, and increases both in extent and depth. See *Neuropathic Ulcers*, under Cornea, Ulceration of the.

The change in the cornea may be modified by the condition of the lids and conjunctiva. A certain amount of conjunctivitis always accompanies neuropathic keratitis; if the secretion is purulent, or if it be allowed to become septic, it may aggravate the corneal trouble. The position of the lids also influences the course of the inflammation; if there be ptosis, from paralysis of the elevator of the upper lid, the nutrition-changes in the cornea will probably be very slight; but if, on the other hand, there be paralysis of the orbicularis, then the destructive changes in the cornea will progress with great rapidity, if care be not taken to close the lids and keep them closed.

Treatment.—Protection of the eye is an indispensable precedent to the success of every other measure. In the majority of cases repair will speedily take place if the lids be closed, and the fluid contents of the conjunctival and lacrymal sacs be kept free from decomposition and other septic deterioration. In mild cases it may be enough to close the lids by means of a well-fitting compress, smeared with lard, vaseline, or, preferably, with boracic acid ointment (gr. xx. ad ℥j.). If, however, the ulceration refuse to heal with simple closure of the lids, then a more effectual exclusion may be secured by paring the edges of the upper and lower lids, and stitching them together, except at the outer and inner canthi, and a small space in the centre of the palpebral fissure. In this way all foreign particles are excluded, at the same time that the secretions of the conjunctiva have a ready exit at the inner canthus. Even when the edges of the lids are stitched, a light boracic acid compress should be worn, and the conjunctival sac should be washed out once or twice a day with boracic acid or quinine lotion. The lids should be kept closed for some weeks after the cornea is healed and all pain or discomfort has subsided.

If there be iritis, atropine should also be applied two or three times a day; and if the pain be great, a hot belladonna compress may be substituted for the boracic acid one.

Herpes of the Cornea.—Arguing from analogy, this is a neuropathic affection, and is indeed sometimes associated with herpes frontalis. Whether accompanied or not by the appearance of vesicles in the area supplied by the ophthalmic division of the fifth nerve, it usually begins with neuralgic pain about the brow and side of the nose, and may be accompanied by pyrexial symptoms—headache and vomiting. Minute vesicles appear on the cornea, disposed in groups or linearly, and raising the epithelium. At first the contents are clear and transparent, but in the course of twenty-four hours they abound in leucocytes. When the vesicles appear, the pain generally subsides. In a few days the vesiculo-pustules burst, giving rise to minute superficial ulcers, which may soon heal without leaving any scar behind. The subjective symptoms are photophobia and lacrymation. In some cases the ulceration spreads both in extent and depth, and may end in destruction of the cornea. The disease usually only affects one eye at a time; but it is liable to recurrence, and then the opposite eye may be affected. *See* Eyelids, Diseases of the; Herpes Frontalis.

Treatment.—Protection of the eye by closure of the lids, either with a belladonna compress or a simple compress of boracic acid ointment. Atropine may be put in once or twice a day, to relieve the pain. Internally, quinine, phosphorus, or arsenic, separately or suitably combined.

2. Inflammation of the Proper Substance of the Cornea.—This occurs in two forms—(*a*) circumscribed, (*b*) diffuse. In both there is migration of leucocytes into the stroma of the cornea; and in both there is but little tendency in the inflammation to go on to suppuration or ulceration.

(*a*) *Circumscribed interstitial keratitis.* Compared with the diffused form of interstitial keratitis to be described below, this is rare. It does, however, occur sufficiently often to merit notice. It shows itself as dense circumscribed infiltration of the substance of the cornea, usually associated with considerable inflammation of the sclerotic, the iris, and the ciliary body. There is great ciliary injection, together with other signs of irido-cyclitis. The infiltrations may occupy any portion of the area of the cornea, though they are generally more pronounced towards the margin, in which case they resemble invasions of the sclerotica into the cornea. Hence the name *Sclerosing keratitis* which has been given to the disease. The corneal epithelium remains smooth, and the infiltrations rarely suppurate or ulcerate. The tension of the eyeball is subnormal, and, in all the cases which have come under the writer's notice, the lids have been considerably discoloured; but in all the discolouration has disappeared as the inflammation of the anterior segment of the eyeball subsided. Subjectively, the disease manifests itself by impairment of sight, photophobia, lacrymation, and general weakness of the eyes. After some weeks or months the infiltrations gradually disappear, though more or less opacity permanently remains.

Causes.—The etiology of the disease has not yet been elucidated. The disease generally occurs in adults, and is sometimes associated with chronic rheumatism. There is no evidence to show that it is connected with syphilis. It is perhaps more common in women than in men.

Treatment.—The disease is chronic, and the treatment must be conducted on the lines laid down in the directions for dealing with keratitis in general. It should, however, be remembered that the disease is not limited to the cornea, but involves the whole of the anterior segment of the globe, including sclera, iris, and ciliary body. The treatment of inflammation of these parts must therefore be combined with that more particularly suited to keratitis. *See* CILIARY BODY; IRIS. Besides the use of fomentations, leeches, atropine, counter-irritation, protection of the eyes, &c., it may be necessary to resort to the operation of iridectomy (q. v.). As regards general treatment, quinine, salicylate of soda, and hypodermic injections of pilocarpine have been extolled. The writer has found Donovan's solution very beneficial in doses increasing (at discretion) from five to fifteen minims three times a day.

(*b*) *Diffuse interstitial keratitis* passes through three well-defined stages—(1) infiltration, (2) vascularisation, (3) resolution. In the *first stage* the cornea becomes more or less hazy, usually beginning at the centre, but gradually invading the whole extent. In addition to the general haze, minute milky-looking dots, resembling 'microscopic masses of fog,' are scattered throughout the substance. In the course of two or three weeks the haziness increases, and the cornea becomes quite opaque. The epithelium at first is unaffected, but it soon becomes steamy, giving, with the opacity of the cornea, the appearance of ground-glass. The subjective symptoms, beyond the progressive impairment of sight, are, as a rule, but slight. Little is complained of beyond a weakness and watering of the eyes. After three to six weeks the *second stage* is ushered in. The perikeratic injection, hitherto slight, becomes more pronounced, and new vessels are seen extending into the substance of the cornea, from the sclerotic and conjunctiva. These vessels may at length become so numerous that the cornea resembles a patch of ecchymosed blood. Usually the vascularisation is not so great, and the cornea is of a pink hue, not unlike the flesh of salmon. Unless the natural history of the disease be known, the advent of this vascular stage is likely to create alarm. The surgeon is distressed to witness the disease apparently progressing in spite of his best endeavours to stay its course. The truth is, however, far otherwise. The formation of new vessels is to be welcomed, not only as affording present safety of the cornea, but as an indispensable condition of ultimate repair. The infiltration is sometimes so great that it breaks through the superficial layers of the cornea and projects from the surface like exuberant granulations. Even when this happens, the hope of recovering useful vision is not to be abandoned. The cornea may eventually clear sufficiently to allow of moderate sight, though a central leucoma may persist. The vascular stage lasts from three to six months, and is followed by the *third stage* of resolution. The discolouration of the cornea begins to fade; the vessels become smaller and less numerous; semitransparent spaces appear between individual vessels, and gradually the vessels shrink towards the margin, till at length they entirely disappear. In the course of three to twelve months the cornea may recover its normal translucency, or retain only a nebulous haze about the centre. Usually, however, the cornea remains more or less hazy throughout its whole extent, with deeper haze about the centre, which prevents perfect acuteness of the sight. Leucomatous opacity does not occur, except in the comparatively rare event of ulceration.

In most cases the iris and choroid are implicated. Iritis and choroiditis seriously complicate the corneal affection. Unless the possibility of their occurrence be kept persistently in mind, the inflamed iris may contract adhesions to the anterior capsule of the lens, with total posterior synechia and obliteration of the pupil. This in turn may lead to inflammation of the ciliary body (cyclitis), of the choroid, or of the vitreous. During the vascular stage the cornea may become so soft that it yields to the intraocular pressure, and a staphyloma results.

The disease usually affects both eyes, though it generally begins in one eye a few weeks, or may be months, before the other. Indeed the second eye sometimes does not show any symptoms till the disease has reached the third stage in the eye primarily affected.

Causes.—Interstitial keratitis is dependent on constitutional causes, though the exciting cause may be an injury. It generally makes its appearance during childhood or adolescence, between the ages of five years and twenty years. Almost invariably it may be shown to be associated with hereditary syphilis, and in most cases positive or circumstantial evidence of this taint may be obtained either from the history of one or both parents, or from the presence of syphilitic lesions in the patient, as nodes, ulceration of the throat, &c. In many cases there is a peculiar and characteristic physiognomy, exhibiting prominent frontal eminences, depressed bridge of the nose, fissures about the angles of the mouth, nose, and forehead, together with a remarkable configuration of the permanent central incisor teeth, which are peg-shaped and notched at their edges. In less typical cases the shape of the teeth resembles that of a screw-driver.

Treatment.—The cyclical character and constitutional nature of the disease must be borne in mind. As far as present knowledge and the resources of therapeutics go, the disease must run its course and pass through its three stages. All that the practitioner may hope to do, is to guide the disease through its various stages, and to obviate complications. The first indication is therefore to alleviate actual pain and to control the local inflammation; the second to expedite and shorten the various stages, remembering always, other things being equal, the shorter the course of inflammation the more complete the recovery. Whatever may be the stage, protection from all irritating agents and influences is indispensable, but particularly in the vascular stage. The treatment must be of a soothing and mildly antiphlogistic character. In the first stage, moist warmth by means of steam, or fomentation either of hot water or of belladonna, gives relief, especially when combined with the instillation of atropine. Care should be taken to protect the eyes by means of spectacles or shades, and astringents and other stimulating applications should be avoided. Atropine should be used, whether the iris be obviously inflamed or not, and the precaution should be taken not to stop its employment because the iris ceases to be visible through the opaque cornea. If there be much supraorbital pain, the application of one or two leeches will give relief. If the iritis be severe and obstinate, especially if the ciliary body be likewise implicated, some practitioners resort at once to iridectomy. The prudence of the practice is, however, debateable. The operation should be reserved for those cases in which the iridocyclitis is accompanied by persistent, increased hardness of the globe, which does not yield to atropine and hot fomentations. The general treatment must have reference to the constitutional condition on which the keratitis depends, namely hereditary syphilis. *See* CONGENITAL SYPHILIS.

3. INFLAMMATION OF THE POSTERIOR LAYER OF THE CORNEA.—The posterior layer of the cornea, consisting of the posterior elastic membrane (Descemet's) and endothelium, is subject to a special form of inflammation. There are anatomical, embryological and morphological reasons for believing this layer to be directly continuous with the choroid. This connexion is likewise indicated in morbid states. Inflammation of the posterior layer of the cornea is always associated with inflammation of the anterior layers of the iris, and probably also of the choroid. Hence the various names which have been applied to this disease, namely, keratitis punctata, serous iritis, aquo-capsulitis, and inflammation of the lining membrane of the anterior chamber. The disease was first described by Wardrop, under the last-mentioned name, about the beginning of the present century. He pointed out that the lining membrane of the anterior chamber has the characters of a serous membrane, and that inflammation of it resembles inflammation of the other serous membranes of the body. The symptoms which he described as characterising the disease were haziness of the posterior layer of the cornea, and deposition of lymph. This deposition usually takes the form of brownish dots, arranged as a pyramid with the apex upwards. The anterior chamber is deep, the aqueous slightly turbid, the anterior surface of the

iris loses some of its lustre, though the fibrillation remains, and the pupil is semidilated. The injection round the cornea is slight and of a delicate pink hue, and often the eyeball is harder than natural. The iris is pushed somewhat backward by the dropsy of the anterior chamber, and, instead of being convex forwards, it is concave. There is total posterior synechia, though the amount of lymph is comparatively small. The pupil does not respond readily to atropine, partly because of the adhesion, and partly in consequence of the increased accumulation of fluid contents within the eye.

Beyond dimness of sight, the subjective symptoms of keratitis punctata are not as a rule very marked. Wardrop called special attention to the subjective sensation of distension and fulness in the eyeball, accompanied by a dull aching pain in the forehead, sometimes also at the back of the head, all of which symptoms are, he said, 'instantly and permanently relieved by evacuating the aqueous humour.'

Causes.—The associated constitutional state is variable, but is generally of that order in which the serous membranes are affected. Rheumatism (simple or gonorrhœal), syphilis, disordered menstrual functions, renal disease, and other toxæmic and septicæmic conditions, predispose to it. In some instances no predisposing cause can be discovered. The writer has so often met with keratitis punctata as the precursor of ordinary interstitial keratitis that he is disposed to believe that, in some degree, it precedes all such cases. In actual practice, however, cases of interstitial keratitis are rarely seen by the ophthalmic surgeon before the parenchyma of the cornea is involved. Keratitis punctata is also one of the earliest objective signs of SYMPATHETIC OPTHALMITIS (q.v.).

Treatment.—The local treatment varies somewhat, according to the state of eyeball-tension. If the eyeball be distinctly hard, and if the hardness do not at once respond to atropine, the cornea may be punctured. This is often followed by speedy relief to pain and rapid subsidence of the inflammation. The hardness of the eyeball might seem to contraindicate the use of atropine, and point rather to the employment of eserine; but it should not be forgotten that the conditions of keratitis punctata are different from those of acute glaucoma, where eserine is indicated. In the former there is a dropsy of the anterior chamber; in the latter the anterior chamber is shallow, and may be obliterated. In keratitis punctata a mydriatic is needed to break down the adhesion of the iris to the capsule of the lens, and to restore the communication between the anterior and posterior chambers. If this be accomplished, the hardness quickly disappears. If there be much pain, leeches may be applied either at the inner or outer angle of the orbit, followed by hot fomentations. Of all internal remedies, the writer is disposed to regard turpentine as the most useful. This drug was originally recommended by Carmichael, of Dublin, for syphilitic iritis, on account of its acknowledged influence in some inflammations of the general serous membranes and especially in peritonitis. He gave it in one-drachm doses; but Chian turpentine in five-grain doses, every three, four, or six hours, is less disagreeable, though it is not quite so active. Cases in which turpentine is administered early seem not only to recover more quickly, but with less permanent damage, than those in which other modes of treatment have been tried. This is particularly true of the gonorrhœal form. Next to Chian turpentine is the employment of mercury in small but repeated doses, especially combined with quinine: from one to two grains of the latter, with one-sixth to one-third of calomel, three times a day. Subcutaneous injections of pilocarpine have been recommended, and are said to have been followed with considerable benefit. After the acute symptoms have subsided, then tonics: iron, quinine, arsenic, phosphorus, with cod-liver oil. *See also* IRIS, Diseases of the.

II. SUPPURATIVE KERATITIS.—Abscess of the cornea may complicate ordinary phlyctenular ophthalmia, but more commonly it is due to traumatic or infective causes operating in debilitated states of the health. It is a common complication of purulent and of diphtheritic conjunctivitis, and is especially prone to occur after smallpox or from slight injuries in persons suffering from chronic conjunctivitis, or who have catarrh and obstruction of the lacrymal sac and duct. Suppuration of the cornea may also be due to an impaired innervation, associated with disorders of the fifth nerve. *See above—Neuropathic Keratitis.*

An abscess being a more or less circumscribed collection of pus within the corneal substance, the fibrillæ are necessarily destroyed, and repair can only take place by cicatrisation. An abscess may form in any part of the depth of the cornea, and may begin at one or several spots. When it begins at several foci, each grows in size till they all run together to form a common collection of pus. Around this collection there is always more or less infiltration of the layers of the cornea. The shape is usually circular, but may be crescentic. If a crescentic abscess form at the lower part of the cornea, it is called by the special name *Onyx*.

Abscess in the superficial layers of the cornea may undergo gradual absorption without opening externally; but when more deeply situated, softening and destruction of the superficial layers take place, and the contents of the abscess escape on the surface with the formation of a deep ulcer. *See* CORNEA, Ulceration of the. Rarely, the abscess opens into the anterior chamber through the posterior layer, forming *hypopyon*; indeed, abscess of the cornea is usually attended with more or less pus in the anterior chamber. The pus in hypopyon may be derived from one or more of four sources:—(*a*) Actual perforation of the ulcer through the posterior layer; or (*b*) infiltration through the corneal canals into the lymphatic spaces at the angle of the anterior chamber; or (*c*) proliferation of the corneal endothelium; or (*d*) by transmigration of leucocytes from the iris and the ciliary body.

Hypopyon, though resembling onyx, may readily be distinguished from it. In hypopyon, the pus in the anterior chamber being free to move, gravitates to the most dependent part of the anterior chamber when the head is inclined; whilst in onyx, the pus, being confined within the lamellæ, cannot change its place.

Perforation of the cornea with entanglement of the iris, or cataract, or even escape of the lens, may supervene as a complication of abscess of the cornea. A peculiar opacity at the anterior pole of the lens is a not uncommon result of suppuration of the cornea in ophthalmia neonatorum. *See* CATARACT.

Treatment.—Abscess of the cornea is not only a painful affection, but it always places the cornea in the greatest jeopardy. It is also an indication of debility, or of impaired innervation, or of local septic influence. Moist warmth, combined with atropine or belladonna, gives relief and promotes the absorption of pus. The effect of atropine should, however, be carefully watched. If the eyeball becomes hard under its employment it should be discontinued, and the cornea should be punctured through the abscess, especially when perforation is imminent. Where there is reason to believe that the pressure of the lid (as in purulent ophthalmia) may be promoting suppuration of the cornea, the lid should be freely cut through vertically and towards the other canthus. This not only removes the pressure, but facilitates the application of remedies. See also *Purulent Ophthalmia*, under CONJUNCTIVA, Diseases of the.

As abscess of the cornea is usually septic, and as, at all events, when disruption of the external layers of the cornea has taken place, infection is liable to take place, antiseptic agents should be used as local applications. Of these, solution of sulphate of quinine is one of the best, for, unlike many other antiseptic agents, it is also antiphlogistic. It helps to arrest the inflammatory process and check the migration of leucocytes. Precautions should be taken against the infection of the cornea with the decomposing contents of the lacrymal sac; any accumulation in the sac should be removed and free drainage ensured.

The treatment of hypopyon may vary with the character of the pus. If this be serous and scanty it will probably soon disappear under the influence of hot belladonna fomentations; but if it be copious and tenacious, section of the cornea must be done across the base of the ulcer, after the plan proposed by Saemisch, in order to evacuate the contents of the anterior chamber. The incision should be made with a sharp and clean Graefe's knife, and a section made by transfixion freely through the whole thickness of the cornea at the seat of abscess, so that the pus may have a free exit. If the hypopyon re-form, it will be necessary to reopen the incision, either by means of a fine probe or by a fresh incision. The drawback to the procedure is entanglement of the iris in the wound. Something may be done to avert this by using atropine or eserine freely, according to the situation of the section and the state of the iris. If the section be near the centre of the cornea, then atropine is indicated, to draw the iris away; if more towards the periphery, then eserine, to contract the pupil and prevent prolapse of the iris into the wound.

Abscess of the cornea is debilitating in its effect, and usually dependent on depraved states of the general health; generous diet and tonics, especially quinine, will therefore be required, in addition to local treatment. JOHN TWEEDY.

CORNEA, Ulceration of the.—The usual antecedent of ulceration is inflammation. In suppuration of the substance of an organ, the tissue-elements are disintegrated by the action of the inflammatory fluids and leucocytes, and a cavity forms which is filled with pus-cells (abscess). The same process occurring on the surface of an organ leads to the formation of a chasm, or ulcer.

It is in this way that most of the ulcers of the cornea are produced, the degree of ulceration being proportionate to the amount and kind of the inflammation. There are, however, other ulcers in which inflammation is either altogether absent, or, if present, is so slight that it cannot account for the degree of ulceration. The probable cause of the latter kind is that the nutrition of the tissue-elements is deteriorated by disturbed innervation. This explanation is fortified by the fact, that such ulcers do resemble those which are associated with appreciable disease of the ophthalmic division of the fifth nerve, and behave in a precisely similar manner.

Ulcers of the cornea may therefore be classified as :—1. Inflammatory; 2. Non-inflammatory (neuropathic). They may be described in the same terms as those of the skin, and like them may be spoken of as spreading, stationary, or healing. In each of these phases the constituent parts of a corneal ulcer present the aspects of corresponding phases of cutaneous ulcers. In spreading ulcers the form is irregular, the edges are elevated, jagged, or sharp-cut, the base is covered with débris, and the adjacent parts are infiltrated with serum and leucocytes. The lamellæ are broken and bend towards the surface. When repair begins, the surrounding infiltration disappears, the base clears, the edges smooth down, new vessels extend from the periphery to the floor of the ulcer, the epithelium gradually encroaches upon it, and at length the breach is filled by cicatricial tissue, never by proper corneal substance.

In ulcer of the cornea there are present most of the objective signs of keratitis, such as redness of the conjunctiva, circumcorneal or ciliary injection, and lacrymation, blepharospasm, &c. The subjective symptoms are pain in the eyeball and around the orbit, and photophobia. These symptoms vary with the degree of inflammation and with the position of the ulcer.

1. Inflammatory Ulcers may be classified as they affect (*a*) the surface of the cornea, or (*b*) the deeper layers.

(*a*) *Superficial Inflammatory Ulcer* presents itself clinically in two forms—namely, the simple and the vascular or irritable.

(1) *Simple ulcer* usually follows the bursting of the pustule in phlyctenular ophthalmia, but may result from any inflammation of the superficial layer of the cornea. A small greyish patch is seen on the cornea, with congestion of the nearest conjunctival and sclerotic vessels. The amount of congestion varies, however, with the degree of inflammation, and with the site of the ulcer. In most cases, if the eye be protected the ulcer soon heals, and its place is marked by a thin scar (nebula). But if the ulcer be irritated, either by topical remedies, or by decomposing secretions of the conjunctival or lacrymal sac or other septic agents, or if it should occur in debilitated persons, or in a cornea damaged by previous inflammation, it may spread into the deeper layers and become the so-called *Deep Inflammatory Ulcer* (q.v.)

Treatment, in the acute stages, is the same as that recommended in phlyctenular keratitis; in the later stages mild stimulation to the ulcer.

(2) *Irritable Vascular Ulcer.*—Sometimes, either from the conditions of health or from inappropriate treatment, the phlyctenular ulcer, instead of undergoing repair, remains vascular, and the granulation tissue fails to undergo cicatrisation. One or two large vessels may be seen extending from the margin of the cornea to the base of the ulcer, which is itself covered by a network of fine vessels. When touched with a probe these ulcers are exquisitely tender; the morbid sensibility in all probability depending upon the presence of exposed and inflamed nerve-terminals. Such ulcers are usually situated just within the margin, but may occur on any part of the surface. They are intensely painful, and are always attended with distressing photophobia and profuse lacrymation. In some cases the pain is so great that it prevents sleep, destroys the appetite, and seriously affects the general health.

Treatment.—Where there is reason to believe that the vascularity of the ulcer is the result of over-stimulation, all that may be needed to ensure recovery is discontinuance of local applications. Should this not suffice, then the application of a solution of nitrate of silver (gr. x.–xx. ad f℥j.), or even the careful application of the mitigated stick of nitrate of silver, destroys the diseased surface and quickly relieves the pain and initiates healthy repair. This treatment is safe, provided the cases are properly discriminated, and is certainly more effectual than the painful and tedious plan of inserting setons into the temple or of applying other forms of counter-irritation.

(*b*) *Deep Inflammatory Ulcers.*—These may be the result of extension of superficial ulcers, or of the opening of an abscess or of an infecting traumatism. Of these deep ulcers it may be stated generally that, unless complicated by iritis, hypopyon, &c. they are not, as a rule, so painful as superficial ulcers, and, conversely, that when a superficial ulcer spreads to the deeper layers the pain often abates. The explanation of these facts is to be found in the distribution and termination of the corneal nerves.

(1) *Suppurative Ulcer.*—In this ulcer the objective signs of keratitis are necessarily always present, and usually most of the subjective symptoms also. It is, however, noteworthy that a deep ulcer, following abscess of the cornea, may be attended with very little pain or irritation. If the corneal affection be complicated with iritis or iridocyclitis, there may be very great pain over the eyebrow and at the root of the nose. The ulcer itself has a sloughy base, and the adjacent portions of the cornea are infiltrated. The anterior chamber is at first usually deep, and may contain more or less pus. The ulceration comprises the deeper layers, and as these give way, a hernia of the posterior elastic lamina (keratocele) occurs, followed after a short interval by rupture with prolapse and entanglement of the iris, so that when it is healed there is a dense opacity of the cornea called 'leucoma,' with an anterior synechia—*leucoma adherens.*

This kind of ulcer is often traumatic, but may apparently occur spontaneously in eyes that have been damaged by previous inflammation, whether phlyctenular or trachomatous. It is, however, frequently met with in connexion with purulent and diphtheritic conjunctivitis, and is then due to the inoculation of the cornea with specific virus. Old age and impaired states of health, from any cause whatever, predispose the cornea to suppurate and ulcerate on comparatively slight excitation.

Treatment.—The indications are: protection and cleanliness, drainage of all secretions, disinfection of the conjunctival and lacrymal sacs by means of antiseptic solutions, moist warmth, either simple or medicated, to allay the inflammation and to relieve pain. If the intraocular tension increases, eserine should be used; and if perforation become imminent, paracentesis of the cornea; or section, after the plan recommended by Saemisch, should be done. When much hypopyon appears, section of the cornea through the ulcer should be performed. If prolapse of the iris take place with the formation of a fistula, the prolapsed portion of the iris must be freely excised, and a compress applied, the aperture being left to heal by cicatrisation. In removing a prolapsed iris, the protruding mass should be grasped close to the level of the cornea, and pulled gently out of the perforation, so as to overstretch it. If the iris then be cut it will retract into the anterior chamber, and so obviate further anterior adhesion. During the process of cicatrisation it may be well to keep the iris under the influence of eserine, to prevent further entanglement, as well as to lessen tension. If, in spite of these precautions, a fresh entanglement occur, especially if it be near the corneal margin, an iridectomy should be done at the site of the entanglement. This not only takes away the risk of glaucoma, but lessens that of sympathetic ophthalmitis.

(2) *Infecting Ulcer* is an extremely obstinate and malignant form of ulceration, and generally ends in perforation, with more or less permanent damage to the eye. Whatever may be the primary cause, when once the ulceration has begun it spreads by infection. The edges creep into the cornea, and extend in all directions. The base is greyish, the edges swollen and irregular, the anterior chamber is deep, the aqueous turbid and contains pus, and there is more or less deposit on Descemet's membrane opposite the ulcer. The ulcer may spread so rapidly that in a few days the whole of the cornea is implicated and converted into a slough. Perforation speedily ensues. When this accident happens there is a sudden cessation of pain, due to the relief of pressure consequent on the escape of the contents of the anterior chamber. From that moment repair may begin. But unless the perforation be large, it is liable to become blocked with tenacious pus and shreds of membrane. In this event there is a recurrence of the pain after a few hours or days. Even when repair does begin, it is slow and intermittent, and the reparative material is apt to break down from time to time. At the beginning this ulcer is seldom painful, though the pain increases as the ulceration extends, and often immediately before the perforation, whether spontaneous or by artificial means, the pain is excessive.

Causes.—It may begin spontaneously, but more commonly it is the result of an injury in which the cornea has become inoculated by the septic matter, or by the decomposing secretions of the conjunctiva or lacrymal sac. It is especially common in farm-labourers, who are liable to injuries of the cornea from thorns or from particles of chaff, &c. It seldom occurs before forty years of age, and is usually met with only in debilitated subjects.

Treatment.—It is in this form of ulceration that incisions of the cornea, as recommended by Saemisch, are of such signal service. *See* above. After incision, warm fomentations and the antiseptic application of perchloride of mercury, quinine, &c., should be freely applied to prevent further infection of the exposed corneal layers. Some practitioners recommend that the base of the ulcer should be scraped, and then either strong solutions of nitrate of silver be applied, or even the actual cautery.

2. NON-INFLAMMATORY ULCERS (NEUROPATHIC).—These ulcers all seem to begin primarily on the surface of the cornea, though they may subsequently implicate the deeper layers, and, like the inflammatory deep ulcers, tend to perforation. In the absence of a degree of inflammation sufficient to induce ulceration, the only sufficient cause seems to be arrested or perverted innervation. Hence these non-inflammatory ulcers may be designated neuropathic.

Ulceration of the cornea, associated with altered innervation, may exhibit as many forms as a corresponding lesion in the skin. In most cases there is a preliminary stage of cell-infiltration rapidly running on to suppuration and ulceration; but it may happen in the cornea as in the skin, that the inflammatory stage is so brief or so slight that the ulceration seems to be a primary phenomenon. Neuropathic ulceration seems to begin at the terminations of the nerves, the kind and extent of the ulceration being dependent partly upon the number of terminals involved, and partly upon the character and seat of the central change. This form of ulceration may therefore be either circumscribed or diffuse.

(*a*) *Circumscribed Non-inflammatory Ulcers* present almost numberless varieties. There are, however, certain well-recognised forms:—(1) Superficial non-vascular ulcer; (2) deep non-vascular ulcer; and (3) the crescentic ulcer.

(1) *Superficial Non-vascular Ulcer.*—This is also called 'ulcer by absorption,' or 'facetted ulcer,' or 'superficial transparent ulcer.' It usually appears in the centre, and apparently suddenly. There is slight depression, with smooth, rounded, non-vascular border. When examined by ordinary daylight the ulcer appears transparent and glassy-looking, and may be easily overlooked. There are few symptoms of inflammation, such as pain, photophobia, or lacrymation. Perhaps the only complaint is that the sight is obscured. The ulcer may remain stationary for weeks, or even months, and it is always slow to recover. It occurs most frequently in children who have delicate skins, who are liable to eczematous and impetiginous disorders, and who are subject to phlyctenular keratitis. Indeed it often co-exists with this disease. When it heals it leaves behind it a semi-transparent cicatrix, producing a facetted appearance.

Treatment.—At first, warm fomentations and protection; later, mild stimulation with eserine night and morning; and, when the vascularity occurs, stronger stimulation with weak yellow-ointment, calomel powder, perchloride of mercury, &c. Care should, however, be taken to avoid over-stimulation.

(2) *Deep Non-vascular Ulcer*, called also *Asthenic Deep Ulcer.*—It usually appears suddenly, and generally about the centre of the cornea, thus resembling the superficial non-vascular ulcer. The edges are deep and irregular, and the outline inclines to an oval. The ulcer rapidly increases in depth till it reaches the posterior elastic layer. Hernia of this layer follows, so that the ulcer may not seem so deep as it really is. The ulcer may remain stationary for many months. When repair does take place, the edges become vascular and rounded off; the cavity is gradually filled up by granulation and cicatrisation. As with the superficial ulcer, the cicatrix is semi-transparent, and leaves a facetted appearance. It is distinguished from the superficial non-vascular ulcer by its great tendency to perforate the cornea, by its occurring in adults rather than in children, and in eyes that are damaged by old disease, as phlyctenular keratitis, granular lids, &c. It is usually symmetrical. In the rapidity of this formation, and in many of its other characters, it resembles acute bed-sore, which is apt to occur in some cerebral and spinal affections.

Treatment.—Treatment must be directed towards preventing perforation and facilitating repair; warm fomentations, compresses to the lids, the cautious application of eserine, to lessen tension and to set up a certain degree of stimulation. If the tension be increased, and the cornea threatened with rupture, then paracentesis through the base of the ulcer, or sclerotomy, may be practised. When the ulcer has become vascular, then mildly stimulating applications like those recommended above may be cautiously employed. As there is great risk of this ulcer becoming infected by the secretions of the conjunctiva, or from the decomposing accumulations in the lacrymal sac, care should be taken to disinfect these secretions, and to secure efficient drainage of the lacrymal apparatus. If, in spite of treatment, the ulcer continues to spread, or refuses to heal, then it is well to employ some antiseptic application, such as quinine lotion, or boracic acid, or salicylic acid, and to tie up the eye with a compress of boracic acid ointment (gr. xx. ad ℥j.).

(3) *Crescentic Ulcer*, though rare, is generally recognised as a distinct clinical entity. In its developed state it appears as a deep crescentic or horseshoe-shaped ulcer just within the corneal margin. In the early stage it begins as one or more opaque dots near the corneal margin, accompanied with some congestion of the adjoining conjunctival and episcleral vessels. Necrosis quickly takes place at these dots, and ulcers form. These ulcers lengthen, so that they become first oval and then curvilinear, always running concentrically with the margin of the cornea. At length two or more of these curvilinear ulcers merge and constitute the crescentic ulcer. At first the ulcers are semi-translucent, but they soon become infiltrated with pus-cells. If unchecked the ulceration destroys the deeper layers of the cornea, and ends in perforation and prolapse of the iris. If, however, repair takes place the infiltration disappears, the edges round off, vessels pass inwards, and healing by cicatrisation slowly takes place.

Crescentic ulcers are generally extremely painful, and attended with great photophobia and lacrymation; they usually occur in persons who are suffering from nervous exhaustion, or who manifest other neuropathic states.

Treatment.—Crescentic ulcers resist all modes of treatment so long as the lids are free to open; but, in the writer's experience, they speedily begin to heal if the lids be securely closed, either by means of a well-fitting compress of boracic acid ointment, or, if necessary, by means of paring the edges and stitching them together. The conjunctival sac should be gently cleansed once or twice a day with boracic acid or quinine lotion, and belladonna fomentation may with advantage be employed to the closed lids for ten minutes at a time every two hours. Internally, tonics, especially quinine, phosphorus, small doses of arsenic and cod-liver oil, are beneficial, and in the later stages, iron.

(*b*) *Diffuse ulceration* is the most frequent form of neuropathic disease of the cornea, and occurs most frequently in association with herpes frontalis. There may be but few subjective signs beyond impaired sight; pain, referable to the eye, may be entirely absent, though there may be excessive pain in the eyebrow, forehead, nose, and temple. The whole of the cornea, but particularly the portion opposite the palpebral aperture looks steamy. The epithelium is sodden, roughened, and disintegrated. Still later the cornea becomes infiltrated, and presents in addition numerous foci of collected leucocytes. At length pus appears in the anterior chamber, the whole of the cornea obviously suppurates, and perforation occurs. In most cases there is more or less iritis of a serous character, a deep anterior chamber with perhaps increased intraocular tension.

Opacities of the Cornea.—Apart from the transitory opacities due to inflammation and the opacity associated with changes of curvature described below, as staphyloma, there are other opacities which are more or less persistent. These are (*a*) cicatricial, (*b*) glaucomatous, (*c*) sclerosal, (*d*) degenerative, as calcareous change in the corneal epithelium, arcus senilis, metallic deposits and stainings.

(*a*) *Cicatricial Opacities* are called 'nebulæ' or 'leucomata,' according to their density. They are the scars left after phlyctenulæ, abscess, ulcer, wound, or inflammation of any kind. As already stated, a leucoma complicated with an entanglement of the iris (anterior synechia) is called 'leucoma adherens.' Slight nebulæ are often more embarrassing to sight than a dense but limited leucoma, inasmuch as the former are often widely diffused. If a leucoma have a well-defined margin, and if it do not cover the whole of the papillary area, there may be good vision past its edge. Old cicatrices are sometimes mistaken for actual keratitis. The polish on the surface of a leucoma, and the absence of circumcorneal injection and the other subjective and objective symptoms of keratitis, should ordinarily render diagnosis easy.

(*b*) *Glaucomatous opacity* appears as a diffused haziness of the whole cornea, with steaminess of the anterior surface, or, in later stages, as a transverse, semi-opaque stripe opposite the exposed part of the cornea. In cases of chronic glaucoma, minute vesicles or bullæ, with ulcerations, may be seen scattered over the surface of the cornea, or involving its depth. The cornea looks like ground glass, and its epithelium is rough.

(*c*) *Sclerosis* is usually the result of circumscribed interstitial keratitis. It occurs, therefore, at or near the corneal margin. *See* Cornea, Inflammation of the.

(*d*) *Calcareous Degeneration* of the corneal epithelium is a very rare condition. A case under the writer's care some years ago exhibited a lenticular-shaped streak crossing each cornea about the middle horizontal line, but inclining slightly obliquely down and out. Underneath the calcareous epithelium the cornea is generally clear.

(*e*) *Arcus Senilis* or *Gerontoxon* is said, on the authority of Canton, to be a degeneration of the periphery of the cornea. This opinion is probably erroneous. Many persons have arcus who show no other evidence of degenerative change; and besides there is no reason for believing that a cornea with arcus heals less readily after operation. The condition is probably rather sclerosis. It generally affects both eyes, and as its name indicates, is more frequent in elderly persons. It usually begins, as a whitish arc, just within the edge of the cornea at the upper and lower parts. A narrow band of transparent cornea is always left between the arc and the sclerotic. In course of time the ends of the upper and lower arcs join and form a white ring. It is always confined to the periphery of the cornea.

(*f*) *Metallic deposits* and *stains* are usually due to iron-rust or to lead deposit, and are removed by scraping and excision.

Treatment.—For cicatricial opacities, if repair be not complete, mild stimulating applications with frictions will often aid in the absorption of the inflammatory matters around and in the cicatrix, and thus help to thin them; but when repair is completed there can be little hope of removing the opacity. If practitioner and patient would recognise that the opacity is really a 'scar' a good deal of disappointment and misunderstanding might be avoided. If the opacity occupy the pupillary portion of the cornea, while the margin is clear, an artificial pupil opposite the clear portion may improve the sight. If, however, the sight be not impaired, or if there be no hope of improving it by operation, something may be done by tattooing the scar to render the blemish less conspicuous.

In glaucomatous opacities, as in ordinary cicatricial opacities, sclerotomy or iridectomy is often followed by considerable clearing of the cornea. In glaucoma, however, where the opacity is very pronounced, the disease is usually beyond any very effectual help from operation, inasmuch as degenerative changes have begun in the posterior segments of the eye, which contraindicate either iridectomy or sclerotomy. But even here eserine is often of service, both in relieving the pain and in removing the opacity. Calcareous epithelium may be scraped off, and so also may most of the metallic deposits and stains. In the case of lead deposit, however, the opacity implicates the stroma of the cornea, and must therefore be cut out with a fine knife. JOHN TWEEDY.

CORNEA, Variations of Curvature of the.—The cornea, as regards its curvature, is practically a section of a sphere. Any sensible deviation from this disposition gives rise to some impairment of vision. If the curvature alone be at fault, the result will be merely an error of refraction, with more or less astigmatism. *See* REFRACTION, Errors of. In many cases, however, both the curvature and the texture of the cornea are involved. In these cases alteration of texture has not only always preceded change of curvature, but is its predisposing cause. The textural defect may be due to want of development, or to intra-uterine disease, or to any subsequent morbid state of the cornea. From one or other of these causes, the resistance of the cornea is diminished, so that it cannot bear up against the intra-ocular pressure, and a bulging, or *ectasia*, results.

ECTASIA CORNEÆ may present itself in one of two forms, viz.:—

(1) Where the translucency is preserved, as in conical and globular cornea.

(2) Where there is more or less opacity —staphyloma.

(1) The TRANSLUCENT ECTASIÆ are (*a*) globular cornea, and (*b*) conical cornea.

(*a*) *Globular Cornea*, kerato-globus, buphthalmos, or hydrophthalmia, is usually congenital, and probably dependent upon corneo-iridian disease occurring during intra-uterine life. It may, however, occur from the same cause operating in early infancy. The cornea is expanded, and may be twice its natural size; the anterior chamber is deep, so that the iris, which is tremulous, seems to have receded; the pupil is distorted and probably adherent to the capsule of the lens; the sight is always impaired; the cornea itself may possess its normal translucency or be opaque in places. The disease usually affects both eyes, though one eye may be more affected than the other. In some cases the enlargement of the anterior segment of the eye may be so great that the lids do not cover it. Ulceration of the cornea is then apt to take place, which may ultimately demand excision of the globe. Otherwise there is little to be done in the way of treatment. Operations are hazardous in such eyes and rarely do good.

(*b*) *Conical Cornea*—Keratoconus.—As the term indicates, the curvature of the cornea in this affection is so changed that, instead of being spherical, it is conical. The conicity usually occurs about the centre of the cornea, and consequently its summit is opposite the pupil. In typical cases the appearance of the eye is characteristic. When looked at from the front, the cornea has a brilliant appearance, as if a drop of dew were lying on its surface; and when looked at in profile, the glistening apex of the cone becomes very conspicuous. The change of shape may often be easily demonstrated by placing the patient opposite a window and observing the alteration of form which the image of the window undergoes as the cornea moves from side to side or up and down. The surest way of discovering conical cornea is to throw light into the eye by means of a plane ophthalmoscopic mirror. A peculiar semirotatory dancing shadow is seen in the area of the red reflection as the mirror is rotated on its various axes. By this means, too, an apparent opacity is often observable, and when the optic papilla is examined by indirect ophthalmoscopy (*see* OPHTHALMOSCOPY), the image of the disc is easily distorted by slight changes in the position of the object lens. Both these phenomena are due to the irregular astigmatism produced by the alteration in the curvature of the cornea. In advanced cases there may be real opacity of the apex of the cone.

The chief subjective symptoms are weakness of the eyes and progressive impairment of sight. Distant objects are seen with increasing difficulty, reading becomes painful, and all near work has to be brought closer and closer to the eye. Hence the patient is thought to be growing shortsighted. These visual defects are but little, if at all, relieved by lenses. Indeed, it is often this circumstance that first suggests an examination of the cornea for conicity. When conical cornea has existed some time, more or less keratitis usually supervenes at the summit, followed by ulceration and cicatrisation. The progress may be slow or rapid. Though the apex of the cornea may be reduced to extreme tenuity, it rarely, if ever, gives way spontaneously.

Causes and Pathology.—The causes are not known. Most authorities believe the change to be of a glaucomatous nature. M. de Wecker has quite recently stated that it is unquestionably due to a glaucomatous state, though he admits the increase of intra-ocular pressure is never sufficiently pronounced to cause excavation of the optic papilla. (*Traité Complet d'Ophthalmologie:* Paris, 1883, t. ii. p. 193). Against this hypothesis must be put the fact that in most cases, and certainly in the worst cases, the eyeball is softer than natural. Indeed, in extreme cases, the apex of the cone actually leaks. Moreover, in conical cornea the anterior chamber is deep, and not shallow, as in glaucoma. Even if the bulging be indirectly dependent upon increased intra-ocular pressure, some other factor must be introduced to account for the *shape* of the bulging. Fluid pressure behind a spherical pressure does not produce a conical protrusion. The writer would suggest that the primary condition is a want of development of the centre of the cornea. In support of this hypothesis it may be mentioned that conical cornea is sometimes congenital, and often hereditary (the writer has known three sisters affected); it usually begins in childhood; it is often associated with a peculiar condition of the skin and teeth, due to ill-development. In typical cases the skin is pale, dry, harsh, and slightly sclerosed, either generally or in patches, with large sebaceous glands which are often blocked with blackened sebum; in some cases there is distinct though slight ichthyosis; the teeth are often honeycombed and deficient in enamel, resembling the teeth so frequently associated with zonular cataract. These facts all point to an embryological origin of conical cornea, and a reference to the mode of development of the cornea shows how a failure of the process of development may leave, in the centre of the cornea, a structural imperfection favourable to the formation of conical cornea.

Treatment may be palliative or curative. Palliative may, again, be local or general. Local: the lenses, spherical or cylindrical, combined, or not, with the stenopaic slit, which are found to give the best sight. Hyperbolic lenses have occasionally been found useful. Solutions of eserine are recommended, partly with a view to lessening the intraocular tension, and partly to diminish circles of diffusion by contracting the pupil. Formerly, the operation of iridodesis was practised, with a view of making the pupil stenopaic; but the operation has wisely been abandoned, on account of its liability to set up sympathetic ophthalmitis. In addition, avoidance of excessive near work is necessary. Small and long-continued doses of arsenic are worth trying, with the hope of favourably influencing the nutrition of the cornea.

The curative treatment varies with the theory of conical cornea. Those who regard keratoconus as glaucomatous adopt measures calculated to arrest the glaucoma, as iridectomy and sclerotomy, and the prolonged use of eserine. This is the line of treatment laid down by De Wecker. Graefe, on the other hand, attacked the apex of the cone, so as to induce cicatricial contraction. The theory propounded in this article indicates operative interference on the apex of the cone itself.

Von Graefe removed a thin layer from the apex without penetrating the anterior chamber. Two or three days later he touched the exposed surface with a stick of mitigated nitrate of silver, and repeated the application every three or four days, in order to set up ulceration. In the third week he punctured the anterior chamber through the base of the ulcer, and kept the opening free for from six to eight days, and then allowed it to heal by cicatrisation. The contraction of this cicatricial tissue led to the reduction of the conicity. This method has been variously modified by others. Bader, for instance, recommends the removal of a small and elliptical flap of the cornea, and bringing the lips of the wound together by means of one or two fine sutures. The practice which is now most commonly followed at Moorfields is that proposed by Sir William Bowman. With a suitable trephine a disc of cornea is cut, care being taken not to penetrate the anterior chamber. The disc is then seized with a fine forceps and severed by means of a cataract-knife. Atropine (or eserine) is then instilled, and the lids tied up with a moist or dry compress. In favourable cases, as cicatrisation of the corneal wound takes place, the conicity gradually disappears, a faint leucoma remaining. If necessary, the operation may be repeated, and eventually an artificial pupil may be made opposite a clean part of the cornea. In some cases the results of these three methods are really brilliant; but, unfortunately, they are all attended with considerable risk of suppuration of the cornea, and consequent destruction of sight. To lessen this risk, the writer has had recourse, in several instances, to multiple puncturings of the apex of the cone with a fine cataract-needle. The summit of the cone is transfixed from three to six times at each sitting, which may be repeated at intervals of two weeks or more. The first effect of the punctures is to allow some of the aqueous humour to escape, and then the eye is firmly but gently supported with a compress and bandage. The pupil is kept under the influence of eserine. Eventually a network of cicatricial tissue forms, which flattens the cone without giving rise to much corneal opacity.

(2) OPAQUE ECTASIA or STAPHYLOMA.—This is bulging of a cicatrix involving any part or the whole of the cornea. It is, consequently, a result of inflammation or injury. In most cases, the inflammation or injury has been attended with perforation. It is especially common after purulent ophthalmia, and suppuration or ulceration of the cornea from any cause. In true staphyloma the iris is entangled in the projecting cicatricial tissue ; hence the peculiar bluish appearance, from which the name staphyloma is derived (σταφυλὴ = a grape). The presence or absence of iris in the staphyloma determines, to a large extent, the gravity of the condition. When the iris is free, staphyloma rarely need give much anxiety; whereas if the iris be involved, there is always a possible danger of sympathetic inflammation of the opposite eye. The bulging may involve only a small portion of the cornea, or it may involve the whole extent. The prospect of recovering any useful degree of sight will depend largely upon the circumstance whether the staphyloma be partial or total.

Partial staphyloma is most frequently found in the lower part of the cornea, that is, the part corresponding with the palpebral aperture. Not only is this portion of the cornea more exposed to traumatic and septic agencies, but, being less supported by the lids, is more liable to give way when weakened by ulceration, or, later, by cicatrisation. On the other hand, staphyloma following purulent ophthalmia in adults is, perhaps, more common in the upper part of the cornea, the presence of the swollen upper lid favouring ulceration of this part.

In total staphyloma there is generally a large entanglement of the iris near the centre. The bulged portion may be so large that the lids cannot cover it. It has a bluish-white appearance, with several large conjunctival vessels running over it from the periphery towards the centre. There is generally a narrow zone of semitransparent corneal tissue between the staphyloma and the sclerotic. In some cases, however, the sclerotic is also involved, or the staphyloma may be at the corneo-scleral junction—ciliary staphyloma. The amount of sight depends largely upon the extent of the staphyloma and the nature and amount of the implication of the iris. If the staphyloma be total, the sight will not be more than perception of light ; but, if partial, there may be even good sight through the transparent portion of the cornea.

The chief complications of both partial and total staphyloma are glaucoma and sympathetic ophthalmitis. *See* Glaucoma; Sympathetic Ophthalmitis.

Treatment.—The prophylactic treatment of staphyloma is identical with that of suppuration and ulceration of the cornea (q. v.). For small staphylomata, without enlargement of the iris, repeated punctures or incisions often suffice, but larger ones may need excision or abcision. When there is entanglement it should, if practicable, be liberated. This may be done either by iridectomy, or by excision of the portion of the cicatrix containing the iridian entanglement. A recent staphyloma is often greatly reduced by iridectomy, and useful sight may be secured. As a rule, however, staphylomatous eyes do not, under the most favourable circumstances, possess good vision, and are at best weak-sighted. If the bulging affect the whole of the cornea, and especially if it be increasing, so as to protrude between the lids and to prevent proper closure of the eye; and still more if there be ulceration with pain, then more radical procedures are called for, either removing the front of the eyeball—abcision—or excising the whole globe. It cannot be denied that ablation of the staphylomatous portion, inasmuch as it leaves a stump for an artificial eye, is a seductive procedure. But as after abcision the patient is still exposed to the risk of sympathetic irritation and inflammation, it is not so much in favour as it formerly was. Of late, the practice of excising the eyeball altogether has steadily grown. By excision, the risks of sympathetic trouble may certainly be obviated, provided the operation be not delayed too long.

New-Growths of the Cornea.—Neoplasmata, beginning primarily in the cornea, are extremely rare. Tumours do, however, begin in the conjunctiva and invade the cornea, or the cornea may be invaded by tumours growing from within the eye. The new-growths which do occur in the cornea are epitheliomata and sarcomata. Pterygium is really an affection of the conjunctiva. *See* Pterygium.

As soon as the nature of either is recognised, enucleation of the globe should be performed. John Tweedy.

CORNEA, Injuries of the.—The principal forms of injury of the cornea are abrasions, impaction of foreign bodies, wounds, and burns.

1. Abrasion of the corneal epithelium, though apparently a trifling accident, is always painful, and may be followed by suppuration and destruction of the cornea. The subjective symptoms are pain, photophobia, lacrymation, and a feeling as if grit were in the eye. Objectively, there is a disturbance of the polish of the corneal surface at the seat of the abrasion; though in the early stages the anterior elastic membrane continues to give a glistening appearance to the base. There is also more or less injection of the globe. The sequel depends upon the precise cause of the injury, the age, and health of the patient, and the kind of treatment adopted.

Treatment.—If the injury be inflicted with a clean instrument, and the patient be healthy, the instillation of a drop of castor oil, and tying up the eye with a soft compress for a few hours, may suffice.

But if the injury be inflicted with a foul instrument, as a dirty finger-nail, or if the patient be debilitated by want of proper food or by drains upon the strength, further precautions must be taken against suppuration. The eye should be tied up with a compress, which should only be removed to allow of the application of hot fomentations of water, poppies, or belladonna, and the instillation of atropine. An aperient should be given, if necessary, but care must be taken not to depress the nutritive activity. If the pain be very great, particularly over the eyebrow and at the root of the nose, one or two leeches should be applied to the inner or the outer angle of the orbit, followed by hot belladonna fomentations. If suppuration of the cornea and hypopyon occur, section of the cornea through the abscess should be made, with the double purposes of getting rid of the pus from the anterior chamber and of lessening the intra-ocular tension. As these untoward results rarely occur except in persons out of health, tonics and generous diet should be superadded to all local measures. Opium, croton-chloral, gelsemin, or conium may be necessary to give freedom from pain and to secure sleep.

2. Foreign Bodies of all kinds may be lodged in the surface of the cornea or become impacted in the deeper layers. In the latter case the track of the extraneous substance may be sagittal or oblique. The impaction of the foreign body may be further complicated by some peculiar quality of this substance; if it be a particle of hot metal there will also be some burning of the cornea; if it be septic, special reaction may follow.

In examining an eye with an alleged foreign body, it is necessary not only to look at the cornea in the manner directed above, but also to search the conjunctivæ of the upper and lower lids. Even though a foreign body be visible on the cornea, this precaution should not be neglected; otherwise extraneous matter may be left under the lids, to the annoyance of the patient and the discredit of the surgeon.

Treatment.—When the foreign body lies on the surface of the cornea its removal is easy. The application of a drop of a two per cent. solution of cocaine, five minutes before attempting the removal, will simplify matters by rendering the cornea and conjunctiva insensitive.

If the foreign body be deeply embedded there may be risk of pushing it through the posterior layers in the attempts to remove it. To obviate this a broad needle should be passed through the cornea behind the foreign body, but without penetrating the anterior chamber. The body may then be removed. But if the foreign body have penetrated the posterior layers and project into the anterior chamber, then the broad needle should be passed into the anterior chamber to support the inner end of the particle, while attempts are made to remove it from the front. Lastly, if the foreign body be forced through the cornea into the anterior chamber, the cornea should be incised, as for iridectomy, and the foreign body removed by forceps, with or without excision of the iris. If the foreign substance be iron or steel it may conveniently be withdrawn from the chamber by means of the electro-magnet. Before attempting to remove fragments that are deeply embedded in the cornea, or which have penetrated the cornea, it is well to apply eserine, in order to contract the pupil and thereby lessen the risk of wounding the lens.

After the body has been removed, a drop of castor oil should be applied and the eye tied up a few hours or two or three days, according to the severity of the injury. Should keratitis supervene it must be treated on the principles laid down above.

3. Wounds of the Cornea may be classified as incised, contused, lacerated, punctured, poisoned, and complicated.

Incised wounds are usually simple in character, and seldom need give anxiety. Contused, lacerated, punctured, and poisoned wounds, on the other hand, are apt to be followed by suppuration. The most serious wounds, however, are those which are complicated by prolapse and entanglement of the iris, by wound of the capsule of the lens, by dislocation of the lens, or by involving the corneo-scleral region, and implicating the ciliary body.

Treatment.—In simple wounds atropine should be applied, and the eye tied up with a light compress. In wounds of a severer kind belladonna compresses, and every other means of preventing or allaying inflammation, should be used. The sound eye should also be protected by means of a shade or tinted spectacles.

Complicated wounds must be treated according to the nature of the complication. If there be a simple entanglement of the iris, an attempt may be made to return the iris; but this failing, the prolapsed portion should be firmly grasped with iris-forceps, and gently pulled forwards so as to detach it from the margin of the wound; and then, while thus over-stretched, it should excised close to the cornea. The resili- of the iris will draw the stump of the into the anterior chamber, and thus prevent further entanglement. Avoidance of entanglement is one of the surest precautions against sympathetic ophthalmitis. If there be a large perforating wound of the cornea with a hernia of the lens, iridectomy should be performed and the lens removed. *See* Cataract. In all cases of wound the local treatment must be soothing and mildly antiphlogistic, and inflammatory reaction should be combated in the manner indicated under *Keratitis*: see Cornea, Inflammation of the.

4. Burns of the Cornea may be caused by hot metals, sparks, lime, ammonia, mineral acids, &c. Burns with lime and strong ammonia are the most destructive, and are apt to cause suppuration or necrosis, and are, under the most favourable circumstances, followed by leucomata. Such burns generally involve the conjunctiva and lids also, and may give rise to adhesions of these parts to the cornea. *See* Conjunctiva, Injuries of the; Eyelids, Injuries of the.

Treatment consists of the removal of all foreign particles, and, if the case be seen early enough, by the neutralisation of the chemical substances—of alkalies by weak acids, of acids by weak alkalies. Later the treatment should be directed against inflammatory reaction, and to putting the cornea in the most favourable state for recovery with the least amount of damage. *See* also Conjunctiva, Injuries of the; Crystalline Lens; Eyelids, Diseases of the; Iris, Injuries of the.

J. Tweedy.

CORNS.—*Definition.*—Local hypertrophies of epidermis, due, for the most part, to the intermittent friction of ill-fitting boots.

Boots, especially of women from their absurdly small size and high heels, throw abnormal pressure on certain spots: but misshapen, loose, ready-made boots may also produce corns by friction. Corns are especially met with on the dorsal surface of the phalanges doubled down and driven under one another, on the outer surface of the little toe, and over the heads of the first and fifth metatarsal bones.

Structure.—This varies somewhat according as corns are hard or soft. (*a*) The structure of *hard corns* is that of a wedge or column-like mass of epithelium, which is driven down on the subjacent papillæ; these soon become depressed and atrophied, the subcutaneous fat disappears and a small bursa often forms, to keep off the pressure on the parts below. (*β*). *Soft corns.*—The chief difference between these and hard corns is that, occurring as they do between the toes, they are spongy, vascular, and covered with soft macerated epithelium. The writer has met with them especially in summer, and in the wearers of patent-leather boots.

The importance of corns depends on the trouble which they occasion, and their *complications*. In early life lateral curvature may take its starting-point in a painful corn, the girl throwing her flexile spine over on to the opposite foot. Abscess under a corn, due to suppuration in the little subjacent bursa; partial dislocation of one or more toes at the metatarso-phalangeal joints due in part to reflex contraction set up by the corns, and in part to the same pressure which has caused the corns, are not unfrequently met with in patients who are well-to-do. Amongst the poorer classes neglected corns have been complicated with cellulitis and erysipelas, or have even, in elderly people, become the starting-point of a fatal gangrene.

Treatment.—The cure of corns would be easy by removing their cause; but few patients obtain a radical cure, as their perseverance ceases as soon as they obtain a sufficient but temporary relief. As a rule patients act upon a too widely spread opinion, viz., that medical men do not know how to treat corns, or, if they do, think them beneath their dignity, and go to some self-dubbed 'chiropodist,' or only present themselves for the treatment of inflammation or some other complication of corns. A medical man should always insist on his patient wearing properly made and well-fitting boots or shoes: these should be neither too large nor too small, with a straight inner border, rounded, not pointed, toes, and low heels; the boots, moreover, should allow of sufficient spring and expansion of the foot in every direction at every step. Patent leather should be forbidden, and the material used be as soft and supple as possible.

In the removal of corns the surgeon should pare a little of the top off carefully, without any attempt to 'cut out' the corn, and then apply, on one or two occasions, a little nitric or glacial acetic acid. A few days after each application the thickened cuticle can be peeled off and a fresh application made, two or three of which are usually sufficient. Of course neither these remedies nor the silver-nitrate in stick (to which the writer considers the former superior), are to be used when the corn is at all inflamed, and in elderly people with feeble circulation, any interference with corns must be undertaken with caution, for fear of causing inflammation which may pass into gangrene. If the patient object to caustics he may apply at night water dressing or a solution of sodæ bicarb., or one of caustic potash well diluted, on lint or cotton wool. A few applications of this will macerate away the chief part of the corn, and the rest will shrivel away, if the patient, having dried the corn well, paint on a solution of silver nitrate, gr. x.–f℥j.

Relief may be given, when any further treatment is declined, by the use of circular perforated plasters of amadou, 'elephant' plaster, or buckskin; but it is always to be remembered that these remedies, while pleasing to the patient, do not cure the corn.

Suppuration under a corn may be known by the presence of a yellow speck at the base of the corn, ushered in by intense throbbing pain. A puncture should be made with a tenotomy knife, and the parts relaxed by the constant application of warm water dressing. Where a row of corns occurs on the phalanges of the toes, crooked and crumpled by the pressure of ill-fitting boots, the toes must first be straightened by splints, aided, if needful, by tenotomy. *See* HAMMER-TOES.

Obstinate ulceration occasionally follows on suppuration and inflammation of corns. *See* PERFORATING ULCER.

Moist corns, between the toes, may easily be cured by keeping the parts very dry, dusting with zinc oxide and starch, or pulv. æruginis, and painting occasionally, if need be, with solution of silver nitrate, gr. x.–f℥j. If moist corns are accompanied by 'sweating feet,' the patient should bathe his feet frequently, and after thorough rubbing and drying, apply lin. belladonnæ, or equal parts of this and eau de Cologne. Socks or stockings, shoes or boots, should be frequently changed. *See* Bromidrosis.

W. H. A. Jacobson.

CORNUA CUTANEA. *See* Horns.

COSTAL CARTILAGES, Fractures of the.—These are very rare, and generally due to the same causes as those giving rise to fractured ribs. The cartilages from the fifth to the ninth are those most likely to be injured. They are frequently complicated by fracture of the sternum, and it is said that injury to the eighth cartilage occasionally may rupture the transverse colon. The pericardium and heart are, however, the thoracic viscera most likely to suffer. The treatment should be the same as for fractured ribs; but if there be deformity a pad and spring pressure may be used to correct this, the elastic structure of the cartilage yielding under the constant pressure. The cartilages generally unite by bone-callus, formed around the broken ends which remain passive in the sheath; but occasionally they unite by new cartilaginous material.

H. G. Howse.

COUNTER-OPENING.—If, after incision of a suppurating cavity, the opening fails to afford free exit to its contents, and the pus either collects at a lower level or has a tendency to burrow along the adjacent soft parts, it will be found necessary to make another incision—the so-called *counter-opening*—in a more dependent or suitable situation, in order to remove this accumulated and probably decomposed purulent discharge. *See* Abscess.

COXALGIA. *See* Hip-Disease.

CRADLES are light arched frames made of wire or cane, which are used to protect injured or inflamed parts from the pressure of the bedclothes. They are made of various sizes, some of sufficient span to bridge across the body, and others merely across a limb. Some cradles, such as Salter's or Arnold's, are of a stronger build, and adapted to suspend a broken limb or diseased joint in a swinging position. In the former the swinging apparatus is suspended from a pulley running on a longitudinal bar; this contrivance prevents the limb being disturbed if the patient slip lower down in the bed. Bilton Pollard.

CRANIAL NERVES, Injuries of the.—I. The Olfactory Nerve.—Blows or falls on the head not infrequently cause separation of the nerves from the lobes, when olfactory anæsthesia—i.e. anosmia—ensues. Loss of the sense of flavour is first noticed, but afterwards that of smell is appreciably lost, as made out by presenting an aromatic oil, such as that of cinnamon or clove, to the nostril. Acetic acid or ammonia irritate the fifth nerve, not the olfactory, and are therefore apt to mislead.

II. The Optic Nerve.—Injuries to the optic nerve, chiasma, and tract exhibit symptoms which depend on the part injured.

Injury to one optic tract causes loss of sight in the corresponding half of the field of vision of either eye—*lateral hemiopia.* This is accounted for by the crossing of the inner set of fibres at the chiasma, so that each tract supplies the same side of both eyes. Injury of the optic chiasma at its margins causes loss of the power of vision on the outer side of both retinæ, appearing in projection as loss of vision in the inner part of each field, i.e. *nasal hemiopia.* Injury to the centre of the chiasma causes loss of function in the inner part of the retinæ, appearing in projection as loss of the outer half of each field of vision, i.e. *temporal hemiopia.*

Destruction of the nerve between the chiasma and the optic foramen causes simply blindness. Injury to the nerve at the optic foramen or within the orbit usually involves other orbital nerves.

III. The Third Nerve is distributed to all the muscles of the eyeball, except the superior oblique and external rectus; to the levator palpebræ; to the sphincter pupillæ, and to the ciliary muscle. *Irritation* of the nerve causes spasm of some one or all of the muscles supplied, but most frequently it is the lateral rectus which is affected, causing internal strabismus; the sphincter pupillæ, causing myosis; and the ciliary muscle, causing the eye to be accommodated for near objects only.

Complete paralysis causes:—

1. Ptosis.
2. Immobility of the eyeball in the position of external strabismus.
3. Dilatation of the pupil.
4. Loss of the power of accommodation.
5. Slight prominence of the eyeball from the compressing action of the superior oblique.

Diagnosis of the seat of lesion:—

1. Injury to the nerve in the crus causes coincident hemiplegia of the opposite side.
2. Both nerves are affected when the interpeduncular space is the seat of lesion.
3. Paralysis of the internal rectus alone causes divergent strabismus and crossed diplopia.
4. When the superior rectus is paralysed, there is crossed diplopia in looking upwards.

5. Exactly the reverse obtains when the inferior rectus is paralysed.

IV. The Fourth Nerve when paralysed causes loss of function in the superior oblique muscle. Owing to the consequent loss of power of rotating the eyeball downwards and outwards there is diplopia, when the patient attempts to look obliquely downwards, from the healthy towards the paralysed side. Giddiness when descending a stair is usually the first symptom, owing to the diplopia induced by looking at the steps whilst descending.

V. The Fifth, Trigeminal, or Trifacial Nerve may be affected in its entirety, in its motor root alone, or in one or more of its primary divisions.

Of the three primary branches the first, wholly sensory, supplies the forehead, upper eyelid, the conjunctiva, the inside of the inlet to the nose and the lacrymal gland. The second, wholly sensory, supplies the cheek from the lower eyelid to the upper lip, including both; the side of the nose, and the upper gums and teeth. The third, partly motor, partly sensory, supplies with motor power the muscles of mastication; and by its sensory branches the lower lip and cheek, the gums and teeth of the lower jaw, the anterior two-thirds of the tongue, the front of the ear, and the parotid gland.

Paralysis from an injury dividing the *sensory* root causes anæsthesia of the regions between the frontal suture and the lower jaw, and between the middle line of the face and the ear. The skin of the face is cold to the touch and exhibits a purplish tint. The conjunctiva may be touched without causing winking, the eyeball looks glazed, and in the course of eight days, if unprotected, the cornea may slough, allowing the escape of the contents. The nostril is dry, and irritation produces neither watering at the eye nor sneezing. The effect of unilateral paralysis causes the patient to think the glass from which he drinks is broken. The tongue on the affected side loses the power of appreciating the presence of sweet, sour, bitter, or saline substances. The gums become spongy and ulcerative. There is diminished secretion in the lacrymal and the salivary glands. Paralysis from severance of the *motor* root is evident by the impaired action of the lower jaw, and by the loss of strength in the masticatory muscles. Irregularity of movement becomes evident, and by placing the hand on the cheek of the affected side, the defective power of the muscles becomes apparent. The impairment in lateral movements is more diagnostic than the simple up and down movement. The diagnosis between central and peripheral affections is made out by observing the following points.

1. When central, the lesion of the fifth is associated usually with hemiplegia of the same side, i.e. the side opposite to the injury.

2. In peripheral affections the anæsthesia is more complete, and in it the trophic and vaso-motor changes are pronounced.

VI. The Sixth Nerve—the abducens—supplies the external rectus of the eyeball. This nerve, on account of its connection with the basal cranial bones, is more frequently involved in fractures of the anterior part of the skull than is any other of the orbital nerves. Its division causes internal strabismus. There is a default in the projection of the field of vision, diplopia of the homonymous type, the images appearing more distant as the object is moved across the field of vision towards the affected side.

VII. The Facial Nerve, or portio dura of the seventh, when torn through, causes paralysis of the muscles of expression—Bell's paralysis. The nerve may be injured after, during, or before its passage through its canal in the petrous portion of the temporal bone—the aqueductus Fallopii.

Injury after its exit from the bony canal causes paralysis of all the muscles of expression—i.e. all the facial muscles, with the exception of the levator palpebræ—of the posterior belly of the digastric, and the stylo-hyoid muscles. The symptoms are:—1, smoothness of the forehead; 2, inability to close the upper eyelid; 3, smoothness of the cheek; 4, loss of the naso-labial furrow; 5, inability to expand the nostril; 6, on laughing the mouth is pulled towards the sound side; 7, whistling, or blowing a candle out, is impossible; 8, food collects between the cheek and the gum. When the injury is three lines *above the exit* of the nerve from the canal, the chorda tympani is paralysed. The patient then experiences a pasty taste in the mouth, and is unable to recognise the difference between bitters and sweets, acids and salines.

When the injury is near the entrance of the nerve into the canal, then the petrosal nerves are involved. See *Spinal Accessory*. When the nerve is injured before its entrance into the canal, the auditory is usually involved. When the cause is central, the sixth is usually paralysed, and there is hemiplegia of the opposite side. When central, the electric response of the muscles and nerves remains active, but when peripheral it is usually lost.

VIII. The AUDITORY NERVE is frequently destroyed by fractures of the base of the skull, by blows, by loud, sudden noises or explosions, as of dynamite. The inability to hear a vibrating tuning-fork placed on the cranium or between the teeth, is diagnostic of complete destruction. Irritation of the part of the nerve supplying the semicircular canals is supposed to produce the giddiness, vertigo, and vomiting characteristic of Menière's disease. *See* EAR, INTERNAL, Diseases of the.

IX. The GLOSSO-PHARYNGEAL NERVE.—Injury to this nerve is unknown apart from its neighbours. When it is destroyed taste proper is lost, and various muscles of the palate are affected. See *Spinal Accessory.*

X. The PNEUMOGASTRIC NERVE, and the part of the spinal accessory applied to it, must be considered together. These endow the circulatory, respiratory, alimentary, and urinary tracts with motor, sensory, trophic, vaso-motor, vaso-inhibitory, secreto-motor, inhibitory, and accelerating fibres.

If the *trunk* of one vagus is destroyed near its root, respiration becomes slower, and, if both be divided, the pauses between inspiration and expiration become more marked, the patient dying of pneumonic congestion. When the pharyngeal branch is destroyed deglutition is impaired, food collects in the pharynx, and fluids taken are ejected through the nose. This probably indicates paralysis of the palatal, as well as of the upper constrictor muscles.

Division of the superior laryngeal nerve allows food to enter the senseless larynx, causing thereby asphyxia. Division of the inferior laryngeal causes paralysis of all the muscles of the larynx, except the crico-thyroid supplied by the superior laryngeal. When this is unilateral, one vocal cord is useless, and being at first semi-abducted and then adducted, causes the voice to be at first hoarse and finally high-pitched. The change is, in all probability, brought about by the increasing tension of the crico-thyroid. Dyspnœa supervenes only during exertion, owing to the inaction of one vocal cord.

When the trunk of the pneumogastric in the neck is paralysed, the recurrent laryngeal suffers; the respirations become slower, the cardiac beat is quickened, and death ensues, usually within half an hour. If, in an operation, the pneumogastric is pulled upon, the heart's action is slowed.

XI. The SPINAL ACCESSORY NERVE.—The accessory filaments to the vagus and its branches supply motion to its pharyngeal, laryngeal, and, probably, its respiratory and cardiac, branches. The portion which takes a separate course supplies the sterno-mastoid and upper part of the trapezius muscles. Irritation of the nerve-trunk causes spasm of these muscles; complete division paralyses them. The head can be maintained in the erect normal position; but shrugging the shoulder, or turning the head so as to hear better, are impossible movements on the paralysed side.

The muscles of the soft palate are affected in paralysis of the fifth, facial, glosso-pharyngeal, pneumogastric, spinal accessory, and hypoglossal nerves. Anatomical teaching ascribes the nervous supply of these muscles to the facial through the fifth for the most part; but clinical observations do not bear out this teaching, as deviation of the uvula—a doubtful symptom at any time—is found when other than these nerves are injured. At present, it is safest to make no definite statements until anatomical and clinical observations are more in accord.

XII. The HYPOGLOSSAL NERVE is chiefly devoted to supplying the muscles of the tongue.

In bilateral paralysis deglutition, mastication, and articulation are hindered or impossible. In unilateral affections these are but little affected, but on protrusion of the tongue it is easy to be seen that it is pushed to the affected side, and *vice versâ* when withdrawn. Paralysis of the palate and one vocal cord has been observed in a case of unilateral paralysis.

JAMES CANTLIE.

CRANIOTABES — CRANIAL BOSSES.—By craniotabes is meant a special form of atrophy, or thinning, of the cranial bones in infancy. The parts affected become flexible like parchment, and small conical pits are formed which commence on the inner table and extend outwards, leaving in well-marked cases only a lamina of the external periosteum. The parchment-like flexibility is easily appreciated when gentle pressure is applied; but the pits are difficult to demonstrate during life, because, except in extreme cases, the outer table retains its continuity of surface. The part of the cranium commonly affected is the posterior inferior angle of the parietal (on one or both sides), and in this position the bone is more easily bent by the finger than in any other, and such bending as can be obtained with moderate pressure is not attended with either risk or pain to the child. There are no symptoms specially suggestive of craniotabes. Infants who have the lesion highly marked, are sometimes very tender about the head, and cry when raised from the horizontal position; but this is by no means constant. The back of the head is often bald. Elsässer, who gave the first description of the lesion, and whose monograph (1842) is admirable, was inclined to look upon craniotabes as the cause of laryngismus stridulus; but there seems no sufficient reason to suppose that the two things, when they coexist, are more than coincidences. It is certain that many cases of craniotabes exist without laryngismus, and many cases of laryngismus occur in children who are not craniotabetic.

The age at which craniotabes is first found is of some importance. There are some exceptional cases in which it appears to be a fœtal condition, and these have special features to be subsequently mentioned; but there is no doubt that craniotabes, as commonly met with, is an infantile and not a congenital lesion. The bones of the vault of the cranium of a full-term fœtus will be found, on examination, tough, firm, and unyielding. Change in shape of the skull of a new-born infant under pressure, is brought about in great part by the overlapping at the sutures, not by the bending of bones. There may be a little yielding along the margin of the sutures; but flexibility of the bone beyond, and actual pits, rarely occur before three months, although they have been detected as early as six weeks. The onset of craniotabes has been repeatedly recognised in infants who were under frequent observation early in life, and who when first examined showed no sign of it. With respect to duration, this lesion may be only capable of detection for a few weeks; in the majority of cases it ceases to be recognisable within the first ten or twelve months of life, but it may continue, in rare cases, up to eighteen months.

The post-mortem appearances present the shallow conical pits already mentioned. These pits are excavations primarily of the inner plate, whilst the apex of the cone is hollowed out of the outer plate, which, in extreme cases, is reduced to a mere membranous lamina of periosteum. The walls of the pit present a markedly granular surface. The size is rarely greater than enough to hold the end of a cedar pencil; the number varies from two or three to a dozen. The pits are generally symmetrical, but deeper and more numerous on one side than the other. The 'place of election' is the posterior inferior part of the parietal. With less frequency the thin upper portion of the occiput, the temporals, the upper surface of the orbital plates of the frontal, and very rarely the upper parts of the frontals and parietals are affected.

Three associated cranial conditions deserve special notice:—(1) The excessive, or rather the premature, formation of convolution-impressions in the hinder parts of the skull. The craniotabes pits are, without exception, situated in these early-formed convolution-impressions. (2) Where the craniotabes is considerable, there is generally also some asymmetry of the skull, and it will be found that, on the side on which the pits are deepest and most numerous, the posterior parietal region is flattened, as a whole, compared with the other side. (3) Cranial bosses. Spots of craniotabes will be found *post mortem* in most of the cases of the so-called natiform skull of M. Parrot, in its vascular and active stage. In this form of cranium, massive bosses occur around the anterior fontanelle, and more or less broad sinuous areas of osteophytic deposit surround, but rarely invade the centres of ossification of the frontals and parietals, and sometimes the occiput and temporals. The association of massive hyperostoses in definite parts of the skull with atrophic areas in other definite parts, is a very remarkable one. Now although a multitude of cases of craniotabes may be found in which at no period are definite bosses to be made out during life, yet a minute examination, *post mortem*, of the outer surface of the cranium in the neighbourhood of the tabetic spots, will, the writer believes, almost invariably reveal a deposit of fine, granular, osseous material. This is sometimes only comparable with what would be obtained by sprinkling over the bone the finest sand. In other cases it is more marked, and can be identified as a 'splash,' so to speak, of the same kind of granular osteophytic deposit which, by insensible gradations, is traceable into the massive bossy growth before mentioned.

Etiology.—No entirely satisfactory explanation of the causation of craniotabes has been offered. The view that the pits represent islands of incomplete ossification in the membranous bones of the cranium is certainly untenable, at least so far as the ordinary cases are concerned. Delayed ossification is by no means a rare condition along the posterior border of the parietal, and along its upper margin, especially near the position normally occupied by the parietal foramina, and such delay may explain some of the flexible parietals which are felt during life; but the actual pits which are seen *post mortem* are well within the sutures, and cannot be so explained. It is true that in skulls of infants who are the subjects of meningocele, small gaps of incomplete ossification may be found in various parts of the cranial bones; but the inner surface of these gaps is quite smooth, instead of presenting the rough granular condition of craniotabes pits, whether the latter have progressed to actual perforation or stopped short of it.

There seems every reason to regard the true craniotabes pits as being due to an actual removal of osseous material from the inner surface by a process of absorption. The doctrine which finds most favour is that the weight of the brain is the efficient cause of this absorption, by pressing against the thinner portions of the hinder part of the cranium, which hinder part also is subjected to counter-pressure from the frequent horizontal posture of the infant lying against the pillow, or on the arm of the nurse. However brought about, it seems probable that in the formation of the convolution-impressions, which are not present at birth, a certain amount of absorption of osseous material takes place. It is possible that an amount of absorption, enough to allow of a slight degree of flexibility of the posterior parietal regions, may be physiological. The writer has, in more than one instance, observed the occurrence of a slight degree of flexibility lasting for a few weeks in a perfectly healthy infant of between three and four months old. But Friedleben's view that actual craniotabes, with the formation of pits, is physiological, appears to the writer quite untenable.

To the two factors of weight and resistance before mentioned, it would appear essential that a third should be added, viz., a special morbid condition of bone by which it becomes more readily acted upon, from within and without, than in the normal state. The writer has already stated his belief that, in however attenuated a lamina, some evidence of fine granular deposit of osteophytic material can generally be found on the outer surface in the neighbourhood of the pits. In the active vascular stage, even the osteophytes which form the massive bosses are so soft that they can readily be cut with a knife. These portions, it is to be remembered, are not subjected to pressure and resistance like the posterior parietal regions. The premature formation of convolution-impressions on the inner surface, and the very marked general flattening of the whole of one posterior parietal region, so often found with craniotabes, form together a strong presumption in favour of the plasticity of this part of the skull. It is true that such asymmetry may be congenital, but its onset may be actually observed in some of the above cases, along with evidences in other parts of the skeleton of yielding to pressure.

It must be admitted that the above view does not explain the rare cases of craniotabes of the upper parts of the frontals, and of the parietals. The full history of these cases is much to be desired, especially with regard to the date of onset. Is it possible that some of them may be truly congenital, and so comparable with a remarkable group described by M. Parrot? This group consisted of premature still-born fœtuses, and the pits were found distributed with remarkable constancy around the neighbourhood of the anterior fontanelle. M. Parrot's ingenious contention was that in intra-uterine life, the head being generally dependent, this region of the inner surface of the skull would be very liable to pressure, and that if any localised morbid condition of bone occurred rendering it soft in this region, intracranial pressure might be expected to come into play.

The question now arises, with what general morbid condition is infantile craniotabes related?

1st. It is not necessarily associated with simple general atrophy or marasmus. Dr. David Lees examined a number of marasmic infants in whom no craniotabes could be found; and, on the other hand, the lesion has been found repeatedly in many stout, apparently well-nourished, children.

2nd. It is certainly found in a high degree in many syphilitic children, and is regarded by M. Parrot as always syphilitic; but it is equally certain that in many cases no evidence of congenital syphilis is forthcoming.

3rd. The prevalent view, first propounded by Elsässer, supported by Virchow, and accepted by most German writers, is that craniotabes is the earliest manifestation of rickets. With respect to this view, it is undoubted that craniotabes may be found in breastfed infants, who at the time present no other sign of rickets, so far as can be detected during the life of the infant, although it may be urged that at a subsequent period, beading of ribs, &c., may become manifest. The writer has, however, recorded one case of craniotabes in a probably syphilitic breastfed child in whom post-mortem examination revealed no proliferation of cartilage at the sternal ends of the ribs, although the child was seven months old, a sufficient age for beading to have become manifest.

The question, however, ultimately turns upon the interpretation which is to be given to the nature of the cranial osteophytes which, in larger or smaller amount, the writer believes always accompany definite spots of craniotabes. If these osteophytes are, as M. Parrot taught, to be regarded as syphilitic, then the craniotabes spots ought to be regarded as a sort of syphilitic epiphenomenon. If, however, the osteophytes are rickety, then the craniotabes spots ought to be considered as a sort of rickety epiphenomenon.

The writer has observed some notable examples of cranial bosses in syphilitic infants in whom other signs of rickets were either *nil* or extremely slight, and, for this and other reasons, was at one time led to believe that M. Parrot's view was correct, viz. that the cranial bosses were in themselves syphilitic. Subsequent investigation has convinced him, however, that, although such bosses occur in a large number of syphilitic children, they may unquestionably arise in non-syphilitic children, and that the older view, according to which they were held to be rickets of the skull, was the correct one.

The difficulty that occasionally other signs of rickets are slight, or even absent, is a real one; but it may be partly met by the parallel observation of the occasional excessive incidence of this disease on particular bones or portions of the skeleton, and by the wonderful variety of clinical forms which occur in consequence of the commencement or arrest of the disease at varying stages of bone-development. The readiness with which the osseous system of a child responds to the slightest perversion of general nutrition is one of the most striking facts of pathology. It seems possible that, even in a breastfed infant, some temporary impoverishment of the mother's milk, some slight chronic catarrh in the infant, or some fault in its surroundings, may start a change in the growing cranial bones, and lead to the deposition of morbid osseous material, in consequence of which craniotabes may follow, and, the cause having come to an end, no further affection of the skeleton supervene.

Thus, as rickets, in its well-marked indubitable forms, may become arrested at various stages, and healthy development occur, so the view may be held that the craniotabetic phase of rickets may remain the only manifestation of the disease, and thus the difficulty of the frequent non-appearance of other classical signs would be met.

Treatment.—Craniotabes, so far as the writer knows, is attended with no special risks *per se*, and needs no special treatment; but its detection ought to set the doctor on the *qui vive* for faults of diet and hygiene, even if no other evidence of rickets be present at the time; and if evidence of congenital syphilis be forthcoming, the child should be promptly treated with mercury. THOMAS BARLOW.

CREPITUS. *See* FRACTURES.

CRIPPS' LONG SPLINT, for fractures of the thigh, differs from all others in that the extending and counter-extending forces are both obtained by the elasticity of a rubber accumulator. The splint is provided with a sliding footpiece, from which a cord passes round a pulley, and then upwards along the outer side of the splint to a double pulley, around the lower wheel of which it is reflected, and then fixed to the upper end of the accumulator, which is itself attached at the other end to one of a series of hooks on the outer side of the splint. The perineal band terminates in a cord at each end; both cords pass over a pulley let in to the upper end of the splint, and join on the outer side of the splint to form a loop, which is placed on the upper wheel of the double pulley above mentioned. It will be seen that when the accumulator is put on the stretch traction is thus made on the perineal band at the same time as on the footpiece. BILTON POLLARD.

CROFT'S PLASTER OF PARIS SPLINTS. *See* IMMOVABLE BANDAGES.

CRYPTORCHISM. *See* TESTIS, Malpositions of the.

CRYSTALLINE LENS. — The crystalline lens presents abnormal and morbid conditions of several kinds. Its *transparency* may be impaired or lost through faults of development or growth, through injury, through senile degeneration, or through malnutrition due to disease of the structures which surround it. Its *elasticity* may be destroyed by the usual senile sclerosis of the fibres, or by morbid changes of structure at any time of life. Its *form* and *size* may be abnormal, by reason of errors of development and growth, or of the mechanical pressure of surrounding structures. Its *position* and *relations* may be at fault through malformation or rupture of its suspensory ligament, through defect of the aqueous or vitreous humour, through adhesion to the iris or other adjacent parts, or through the presence of foreign bodies or new-formations in its neighbourhood. Having no nerves, no blood-vessels, and no connective tissue in its substance, the lens is not subject to those morbid processes which depend on the presence of these structures. Its most frequent and most important disorder is the condition known as cataract. *See* CATARACT.

MISPLACEMENT AND DISLOCATION OF THE LENS.—Instead of hanging evenly suspended behind the pupil and concentric with the axis of the eye, the lens may assume various abnormal positions. It may be displaced laterally with or without tilting of the one edge in advance of the other; it may pass through the pupil into the anterior chamber; it may fall back into the vitreous humour; it may even, in case of forcible rupture of the sclera, be driven out of the eye and remain lying beneath the conjunctiva.

Causes and Pathology.—The causes of these displacements are of three kinds—errors in development; injuries; and degenerative processes affecting the integrity of the suspensory ligament.

Congenital misplacement is sometimes associated with coloboma of the choroid or optic disc, sometimes with persistent hyaloid artery; more frequently it is met with in eyes which appear otherwise healthy. A partial lateral displacement indicates a faulty development of the suspensory ligament, by reason of which the traction upon the lens is unequal at different parts of its circumference. The displacement is usually upwards, or upwards and outwards, indicating a defect in the lower part of the ligament analogous to an imperfect closure of the fœtal slit. It is usually present in both eyes, and is symmetrical, or nearly so, in the two. It has been frequently met with in several members of one family, and in successive generations.

Traumatic dislocation may be produced by perforating or by non-perforating injuries, more frequently, perhaps, by the latter; the suspensory ligament ruptures under violent distortion of the globe, and the lens is displaced in the direction of least resistance. The attachments of the lens to its ligament and to the hyaloid membrane are less strong in senile than in youthful eyes, and they are weakened by conditions which damage the nutrition of the vitreous humour; in such cases, therefore, less force suffices to dislocate the lens than in a sound and youthful eye.

Spontaneous dislocation occurs only in presence of morbid changes in the lens itself, or in the vitreous. These structures depend for their nutrition upon the uveal tract, and when this latter passes into an atrophic state—e.g. in retinitis pigmentosa, choroiditis disseminata, extreme myopia, &c.—they are apt to degenerate, the one liquefying, the other developing the posterior-polar form of cataract. It is in these same conditions of uveal atrophy that spontaneous dislocation of the lens is chiefly met with. It is promoted also by those pathological changes which overstretch the suspensory ligament, namely, by the shrivelling of the lens which usually occurs in the hypermature stage of cataract, and by the distension of the ciliary region which results from the long continuance of glaucomatous tension. A lens misplaced at birth may, and not unfrequently does, in course of time break loose still further from its suspensory ligament, and undergo a spontaneous dislocation into the vitreous or the anterior chamber; the deep-seated changes just referred to are, of course, not to be looked for in such a case.

Symptoms and Diagnosis.—*Lateral displacement*, such as occurs congenitally, involves more or less defect of vision; usually there is myopia, and sometimes astigmatism also. If the displacement be so great as to bring the one edge of the lens well within the area of the pupil, the eye has, as it were, a double refraction, being, as regards the free part of the pupil, hypermetropic, as in aphakia (absence of lens); while, as regards the part occupied by the lens, it is myopic, or, at any rate, very much less hypermetropic. Moreover, the retinal image is doubled, for the eccentric lens acts as a prism, and deflects to one side the rays which traverse it, while those which pass by it are not so deflected. Hence the patient has a peculiar confusion of vision, and may see double with a single eye. A concave lens, combined, if necessary, with a cylinder, may give good vision through the displaced crystalline, while a cataract-glass may do the same for the free area of the pupil. In either case, the patient may succeed in disregarding the second image, especially as by the action of the glass it is rendered all the more diffuse. Objectively, the displacement reveals itself by tremulous movements of the iris when the eye is quickly moved in different directions.

These indicate a loss of the fixed support which the iris normally receives from the lens, and correspond with similar tremulous movements of the lens itself. The anterior chamber is seen on careful inspection to be unequally deep at different parts, being too shallow at the side towards which the lens is displaced, too deep at the opposite side. With the ophthalmoscope the edge of the lens presents the striking appearance of a dark line, well-defined on its convex side, shading off more gradually on its concave side, crossing the pupil near to its margin. If the displacement be slight, the dark line will be visible only on looking obliquely behind the margin of the pupil. It is due to the fact that rays of light falling on the extreme edge of the lens strike it at such an angle as to be totally reflected from its surface, instead of passing through it. The free area of the pupil gives a brighter reflex from the fundus than the part occupied by the lens, and if it be large enough to permit of an examination of the fundus through it, two images of the disc may be seen at once, for the same reason that two images of an external object are formed upon the retina. It is asserted that congenitally displaced lenses are usually of subnormal size, but there is no decisive evidence on the point. A lens of this kind, recently removed by the writer from the anterior chamber of a boy aged 6, measured 7 mm. transversely, 4·75 mm. antero-posteriorly, and weighed 129 mgrms.

Dislocation into the anterior chamber is always noticed by the patient as producing marked and sudden impairment of vision—a high degree of myopia—and in some cases is very shortly followed by the onset of glaucomatous symptoms of a very severe character. Objectively, it gives rise to the peculiar appearance of a shining yellow circle, or golden ring, in the anterior chamber; this, like the dark line already described, is due to a total reflection of light at the edge of the lens. The lens may lie completely on the anterior surface of the iris, or it may remain more or less embraced by it. The pupil, and so much of the iris as is seen through the lens, are unusually magnified. If small and smooth, the lens may lie for a considerable time in the anterior chamber without causing pain or serious irritation, and it may from time to time, with changes in the position of the head, return to its original place behind the iris, and again fall forward through the pupil. In the case of the boy above referred to, it was possible at any time to bring the lens into the anterior chamber by giving the head a jerk. In eyes long blinded by iridocyclitis and other deep-seated changes, a degenerated and calcareous lens will sometimes fall forwards into the anterior chamber, and light up a fresh injection of the eye. Whether cataractous or clear, a lens remaining in the anterior chamber leads, sooner or later, to secondary opacity of the cornea and to ciliary injection.

Dislocation into the vitreous can be diagnosed only by means of the ophthalmoscope, or in some cases by focal illumination. The lens is seen lying in the lower part of the vitreous chamber, and oscillating from side to side with the movements of the eye. If the function of the retina be not lost, the best vision will be obtainable by means of a strong convex lens, as after cataract-extraction. Cases are on record of persons thus affected who could, by placing the face in the prone position, bring the crystalline into the pupillary region, and, for the time being, obtain excellent vision by that means. On the other hand, a lens lying unattached in the vitreous may, in consequence of such a prone position of the face, fall through into the anterior chamber, and at once set up serious symptoms. Lenses dislocated into the vitreous have been known to remain transparent for years, but their usual tendency is to become semi-opaque. In rare instances they gradually disappear, apparently by absorption.

Each of the three forms of displacement above described may arise as a direct result of injury. In such cases other symptoms, such as wound of the tunics, hæmorrhage into the chamber, or rupture of the iris or choroid, are usually present, and the eye frequently becomes glaucomatous. Secondary glaucoma, of very sudden and severe type, occurs also in some cases of spontaneous dislocation of the lens; the mode of its production deserves special consideration. A lens in the anterior chamber may form a complete barrier to the escape of the intraocular fluid from the eye. Under normal conditions, the stream which passes from the posterior to the anterior chamber on its way to the outlets in the neighbourhood of Schlemm's canal, raises the iris to an imperceptible extent from the surface of the lens, and meets with no resistance at the pupil; but when the lens lies in front of the iris, this same stream tends to press the iris against it, and, if once its passage through the pupil should be stopped, the accumulation which ensues in the posterior chamber drives the iris forwards still more forcibly, and, as the pressure rises, the blockade becomes more and more complete. The periphery of the iris, where not supported by the lens, is then driven forwards until the angle of the anterior chamber is closed by contact of the iris with the cornea. An intensely acute glaucoma may arise in this way simply through the spontaneous falling of the lens into the anterior chamber; and, what is still more remarkable, the glaucomatous tension may effect its own relief, by driving the iris forwards round the margin of the lens until the latter falls back again through the pupil, whereupon the filtration channels are reopened, and the glaucoma is at an end, until the accident occurs again. The glaucomatous complication occurs more readily when the lens is large than when it is small—in other words, it occurs more readily in the old than in the young. A lens dislocated laterally behind the iris may cause glaucoma by pressing against the ciliary processes at the side towards which it is displaced, and thus closing the angle of the anterior chamber throughout a considerable part of the circle. Cases in which a mechanical production of glaucoma by a dislocated lens in the way described was proved by dissection have been recorded by the writer (*Ophth. Rev.* vol. i. p. 209; vol. ii. p. 257).

Treatment.—A congenital partial displacement, so long as the lens remains transparent, admits of no satisfactory treatment beyond a correction of the refraction according to the indications already given. Should the lens become opaque, an attempt may be made to remove it, or the safer plan of making an iridectomy in the direction opposite to that of the displacement may be adopted. This gives an eccentric but clear pupil which, with the help of a cataract-glass, may permit of good vision. Should a congenitally displaced lens fall into the anterior chamber, it should, as a rule, be removed without delay. Possibly it may return spontaneously, once or twice, to its former position behind the iris; possibly it may be kept there a while by the persistent use of eserine; but temporising will in the end prove useless: it is best to remove the lens before inflammatory or glaucomatous complications are set up. It may be needled if the patient be young, or it may be extracted entire through a corneal incision of sufficient size. In order to prevent the lens from falling back through the pupil at the time of the operation, the iris should be well under the influence of eserine; but this should not be applied until shortly before the operation, for contraction of the pupil under these circumstances has been known to induce glaucoma in the way above referred to. If a sufficient support to the lens cannot be obtained in this way, it should be fixed with a needle passed through the cornea while the incision is made. It will escape through a suitable incision without traction. An escape of vitreous is inevitable. In cases of traumatic dislocation into the anterior chamber, immediate extraction of the lens may afford the only chance of saving the eye, especially if glaucoma be present, but it is hazardous. A lens lying in the vitreous can rarely be extracted with safety to the eye. In all cases of dislocation of the lens in which vision is already lost, and in which treatment is necessary, enucleation of the eye is the safest course.

Priestley Smith.

CUPPING may be Wet or Dry. Wet Cupping is a method of blood-letting in which blood is taken from a number of small incisions by atmospheric pressure.

Situations suitable.—Any region which is smooth and fleshy; hence in fat persons a large number of parts are available. In emaciated subjects, the nape of the neck, loins, buttocks, &c.

Parts to be avoided.—Irregular surfaces of all kinds (e.g. over the intercostal spaces in the very thin), regions over sensitive organs—as the mamma, and the immediate neighbourhood of inflamed skin or cellular tissue.

Apparatus required.—Cupping-glasses of several sizes, scarificator, spirit lamp, hot water, sponge, and bleeding bowl. The *glasses* are bulbous in form, contracted at the mouths, which may be oval or circular; the latter are the easier to apply. The *scarificator* is a small machine fitted with a number of fine blades (from 3 to 12 in number), which can be withdrawn and suddenly projected, by a spring and trigger arrangement, from a flat plate which is applied to the surface of the skin. The knives can be set at any depth, and should be so adjusted as to cut through the '*cutis vera*' *only*, which varies in thickness in different situations.

Operation.—With a warm sponge moisten the selected spot, take the cupping-glass, which should have been lying in hot water, and *partially* exhaust the contained air by placing the flame of the spirit lamp in its interior; the lamp having been quickly withdrawn, place the mouth of the glass evenly on the part to be cupped, whereupon the soft tissues within the rim should swell and project towards the glass cavity. Several glasses may be applied side by side in this manner until a considerable area is covered, but care must be taken that they are not placed in *actual contact* with one another. After an interval of one minute, remove the glass by tilting it to one side, press the scarificator, already properly adjusted, on the swollen part, discharge the blades, remove it instantly and reapply the glass as quickly as possible in the same way as before. Blood should then flow from the cuts until the vacuum in the glass is destroyed. The flow having ceased, remove the glass with its contents, sponge the part with warm water, and, if necessary, apply another glass. As a rule not more than about two or three ounces will be obtainable from one application of the scarificator, which must never be applied in exactly the same place a second time at one cupping. After the operation, bleeding stops spontaneously, and a piece of strapping may be put over the wounds.

Caution.—If no blood follows the application of the glass after the use of the scarificator, one of the following causes will probably exist:—(1) Improper adjustment of the blades; if these cut *too superficially*, the vessels are not laid sufficiently freely open; if they cut *too deeply*, the subcutaneous fat is invaded and projects into the wounds, effectually plugging them. (2) Insufficient or complete exhaustion of the air in the glass. In the former case the vacuum is too slight to produce any material flow; in the latter the pressure on the parts under the rim is so great that the vessels are occluded.

In addition to the glasses already mentioned, others may be obtained which are fitted with an arrangement by which they are exhausted by means of a syringe, so that the spirit lamp is not needed; but they are not so effectual as the simpler form.

Dry Cupping.—A method, seldom useful in surgery, by which the congestion of deep structures is said to be relieved by causing a temporary determination of blood to the surface of the body by the application of cupping glasses in the manner described in the first stage of wet-cupping.

William H. Bennett.

CURVATURE OF THE SPINE.

See Antero-Posterior Spinal Curvature; Lateral Spinal Curvature; Caries of the Spine.

CUT-THROAT.

See Throat.

CYLINDROMA.

See Sarcoma.

CYNANCHE.

See Pharynx; Tonsils.

CYPHOSIS.

See Antero-posterior Spinal Curvature.

CYSTICERCUS CELLULOSÆ

—more properly known as the cysticercus telæ cellulosæ—is the cystic form of the tænia solium or common tapeworm; and, if we except a doubtful case of C. tenuicollis, is the only form of cysticercus known in the human body.

Cause.—One of the matured segments of a tapeworm, with its already developed embryos, has but to be swallowed to undergo further development. Located in the stomach of a pig it speedily bores its way into the tissues of its host, becomes encysted, constituting the condition which is known as measly pork, which condition is precisely analogous with the C. cellulosæ of man. According to Leuckart, the segments of the tapeworm need not pass into a second individual, but may infect the person who is already affected with tapeworm. The cysticercus may be found in one part only of the body, or may pervade the whole, as in a remarkable case recorded by Delore, in which over two thousand cysticerci were found after death. They were distributed all over the various tissues, from the brain to the skin, but had not contributed apparently in any way to produce death. The cysticercus is found most commonly in the connective tissues, with scarcely less frequency in the muscles, and more rarely in the various organs and in the skin. In a few cases it has appeared in the aqueous or vitreous chambers of the eye.

Diagnosis and Symptoms.—As a rule there are but few symptoms which will lead to correct diagnosis during life. Unless the cysts are in some superficial position, their very existence cannot be conjectured; indeed it is possible, as in Delore's case (*supra cit.*), that the whole body may be riddled with cysts without their presence being suspected. If they approach the surface, it is more than probable that their true nature will only be revealed by the aid of the surgeon's knife. In the brain they have been known to give rise to epileptiform, maniacal, and other obscure nervous symptoms, the true import of which could only be determined by a post-mortem. When the parasite makes its appearance in any part of the eye, it can as a rule be readily detected, at least by the aid of the ophthalmoscope. On this point our chief knowledge is derived from Von Graefe, who enjoyed considerable opportunities for studying the subject. He describes two kinds—the free and the encysted form—the former being probably due to the rupture of the cyst-wall, and having been seen, so far, only in the aqueous humour or lens capsule, whilst the encysted form grows in or behind the retina.

The *symptoms* to which such a cyst will give rise depend greatly upon its situation. In the deeper parts of the eye its presence is chiefly characterised by a gradually advancing blindness, leading in some cases to total disorganisation of the eye and permanent loss of vision.

If a suspicious cyst, whether situated in the eye or elsewhere, has been opened, its contents should be examined microscopically for hooklets. If enough of the fluid can be obtained, it should be tested for chlorides, which it contains in great excess. It rarely contains albumen. The specific gravity varies from 1,005 to 1,008 usually.

If the cyst comes away as a whole, the coiled-up worm should be looked for. The condition of the worm will vary with the age of the cyst.

Treatment.—Before discussing the question of treatment, it is of the greatest importance to bear in mind the natural term of existence of the cysticercus, after which it undergoes a gradual diminution in size, mainly owing to the absorption of its fluid and calcareous degeneration of its envelopes, which processes terminate its existence within eight months of its first appearance (Cobbold). Such being the natural process of cure, the prognosis is almost invariably good where a correct diagnosis has been made. If a cyst has been discovered in any obvious position, it can either be dissected out or freely opened and drained, or packed with lint and allowed to heal from the bottom. The situation must determine which mode of treatment is to be preferred. *See* HYDATIDS.

In the case of the eye, if the cyst is situated in the anterior chamber or lens, it admits of removal if necessary; but if placed in the vitreous, or attached to the choroid, no operative treatment is admissible, unless so much inflammation should chance to be set up as to make it advisable to remove the eyeball. Every operation that has been attempted for removal of the cysticercus from the vitreous humour has resulted in complete failure. W. BRUCE CLARKE.

CYSTIC TUMOURS.—As non-malignant growths, these tumours may consist of a cluster of cysts, or cysts may be interspersed in a solid matrix, or a cyst may have solid matter growing up within it, and thus more or less completely filling up its cavity. As to situation, they are found most commonly in the breast, the ovary, the thyroid gland, and the lower jaw.

Cause.—No cause peculiar to these tumours can be assigned for their occurrence.

Pathology.—Some of the cystic tumours of the ovary are seen to have arisen from a cluster of enlarged Graafian vesicles, which are again enclosed in a common capsule—that of the ovary. These cysts, as they enlarge, coalesce by the absorption of their common septa, and thus gradually merge into one or more large cysts. The evidence of these changes is seen in the numerous fenestræ, all having curved borders, which mark the inter-cystic communications. In other cystic tumours well-defined cysts may be seen scattered through or intertwined amongst solid growths, and are termed 'exogenous cystic tumours.'

In a third variety, termed 'endogenous tumours' or *proliferating cystoma*, the solid growths are attached to and spring up from some part of the walls of the various cysts, and may fill up and obliterate the cysts. The sero-cystic disease of the breast is a tumour of this character. The solid growth is composed of fibro-cellular elements, and not infrequently may be a spindle-celled 'sarcoma.'

Another variety of a mixed fluid and solid tumour occurs in the softening or cystiform degeneration of fibrous and other tumours, the result being that definite but not encapsuled collections of fluid are produced which may contain serum—pure, or mixed with blood—or a mucoid material. These changes are more prone to occur in malignant than in non-malignant tumours.

Diagnosis.—A cystic tumour grows to a large size without giving rise either to inflammation or ulceration. It is seen to be lobulated; the apparent lobules are the component cysts, which plainly fluctuate; the skin is often thinned in places. As a rule these tumours do not cause much suffering. When occurring in the breast, the nipple, if displaced, is not retracted, and the axillary glands, when affected, are generally simply enlarged, and not indurated.

Treatment.—Cystic tumours should be removed early and completely. If this proceeding is impossible, and the cysts are few and large, they may be tapped, and in rare instances treated successfully by iodine injections or by setons.

ALFRED WILLETT.

CYSTINE or CYSTIC OXIDE. *See* Calculus, Urinary.

CYSTITIS. *See* Bladder, Diseases of the.

CYSTOCELE, a tumour formed by the prolapse of the bladder into the vagina. *See* Vagina, Affections of the.

CYSTOPLASTY. *See* Ectopia Vesicæ and Epispadias.

CYSTORRHŒA. *See* Bladder, Diseases of the.

CYSTS.—By the term 'cyst' is meant a collection of a fluid, non-inflammatory in its nature, which is contained in a single closed bag termed the 'sac.' A cyst, unless there is an occasional accidental discharge of its fluid contents, is a permanent and usually an increasing swelling, the contents of which, whilst varying in character as well as in consistency, are capable of complete evacuation when the cyst is laid open. There are two clear distinctions between cysts and cystic tumours, the first, that a cyst contains within it nothing of the nature of a new growth, and the second, that all the fluid in the tumour is contained in one sac. Hence the terms 'a cyst' and 'cystic' convey quite distinct ideas of the nature of any tumour.

The varieties of cysts are very numerous, not because the actual nature of the sac itself varies much, but because of the very varying nature of the origin and, still more so, of the contents of cysts. A source of confusion moreover exists, viz. that of fluid swellings having precisely the same nature pathologically, some may be regarded as cysts, i.e. tumours, whilst others never have these appellations given them. Cysts receive their distinctive names generally from the nature of the fluid contained within the sac, whilst they are classified according to the manner of their production. Thus cysts are styled serous, synovial, mucous, sanguineous, milk, salivary, oil, seminal, colloid, sebaceous, dermoid; whilst, when classified, they are described as exudation, retention, new-formation, congenital, and parasitic cysts. A brief explanation of the typical forms of these classified cysts is perhaps necessary, whilst any special description of the designated cysts can scarcely be required.

Exudation Cysts are formed by the distension of a pre-existent space, varieties of which are seen in the synovial cysts of chronic bursal effusion or of ganglia, and in the serous collections in tooth-sacs; whilst hydrocele of the tunica vaginalis—a swelling of this nature—is not called a cyst.

Retention Cysts are those in which the orifice of a duct from some cause closes up or is obstructed, so that the secretion being pent up accumulates and distends the duct forming a tumour, of which the ordinary sebaceous cyst in the skin, the mucous cyst of the lips and of the vagina, milk cysts of the breast, salivary cysts, such as ranula, and seminal cysts of encysted hydrocele, are illustrations.

The New-formation Cysts comprise instances of nearly all the named cysts, some of the more noteworthy being the large serous cysts found in the neck, under the name of hygroma—collections of fluid diffusing themselves widely, yet never becoming tense—thyroid gland cysts, mammary cysts—some of which evince no disposition to proliferate, as, on the contrary, do most of the ovarian cysts—and parovarian cysts of the broad ligament.

Under *Congenital Cysts* are placed, meningocele (somewhat erroneously), congenital cysts of the neck, dermoid cysts, so frequently found at some point around the orbits, and especially at the outer angles, and the ovarian dermoid cysts.

Amongst *Cysts of parasitic origin* the chief is the well-known hydatid cyst of the liver and elsewhere.

Pathology.—In a cyst, regard has to be paid to the investing membrane or sac, and the nature of the contents. The contents of most of the cysts being natural secretions, only such changes would occur as condensation or inflammation might effect. Of the sac, it has to be noted how greatly it varies in substance. In hygroma of the neck it is so thin and delicate as to be scarcely separable, whilst in some ovarian cysts it may be one-fourth of an inch in thickness. In serous cysts which have not been inflamed the lining membrane is smooth and glistening, whilst in others it has a rough and leathery appearance.

On its outer aspect, if placed in a serous cavity, a cyst will of course be covered by this membrane, but under other conditions it may be loosely invested with areolar tissue, or so intimately blended with the structure in which it has been developed that the sac cannot be detached. The intervening portion of cyst-wall consists mainly of fibrous tissue, with perhaps some tissue-elements indicative of the part in which the cyst has developed. Often, too, the configuration of the cyst may indicate the mode of its production, being either long and tapering or irregularly pouched.

Symptoms and Diagnosis.—The physical symptoms of a cyst might shortly be described as those of a chronic abscess, except that, as a rule, a cyst is more tense; hence, elasticity, fluctuation, or undulation become the symptoms most to be depended upon, as the cyst varies from a tense hard swelling to a soft flaccid one. Inasmuch, then, as the existence of fluid in a sac is seldom difficult to diagnose, and since the doubt, where it exists, as well as the nature of the fluid can be at once cleared up by an exploratory puncture with an aspirating needle, it is needless to lay stress on the diagnosis of cysts.

Treatment.—The mode of dealing with cysts is governed partly by their nature and partly by reference to the structure in which they are placed, or the organ with which they are associated.

The most effectual way of dealing with a cyst of moderate size which has no entangling connections, is to excise it, taking care, as a rule, to remove the cyst-wall. In others, such as milk cysts and most of the simple serous cysts, if a single tapping fails to cure, the better course is to lay open the sac and effect its cure by granulation; whilst the large cysts of the neck, after tapping and evacuation, may be injected with iodine. In a few cases, where pressure can be adequately employed, cysts may be cured by this means—of course, after evacuation of the contents. ALFRED WILLETT.

D

DACTYLITIS. — Inflammation of a finger, e.g. dactylitis syphilitica. *See* HAND, Surgery of the.

DALTONISM. *See* COLOUR-BLINDNESS.

DAVY'S LEVER.—This instrument, used by Mr. Richard Davy for compressing *per rectum* the aorta and the iliac arteries, consists of a straight and smooth cylinder of ebony from 18 to 22 inches in length, and with a maximum diameter of five-eighths of an inch. The rectal portion, which has a slightly bulbous extremity, is graduated to an inch scale, so that the length of cylinder passed into the rectum can always be readily determined. This is introduced into the rectum as far as the common iliac artery or the aorta, its projecting part being kept nearly parallel to the opposite thigh, and, when it is supposed that the vessel has been reached, the external arm of the lever is raised, the perineal tissues acting as a fulcrum. Compression of the artery by the rectal end of the lever is indicated by arrest of the pulsations of the femoral artery. This method of restraining hæmorrhage, though practised most frequently in cases of amputation at the hip-joint, has been advocated by Mr. Davy as applicable to any surgical procedure where it is desirable to check for a time the blood-current through the aorta or the iliac arteries. It has recently been applied with success in two cases of large traumatic aneurism of the gluteal artery treated by incision and double ligature. The most salient advantages of rectal compression by the lever are held to be, perfect control of the artery with a minimum amount of disturbance of the circulatory system. This instrument is certainly very useful in effecting temporary arrest of the circulation of the lower extremity, and has been applied with success in a long series of cases. It needs, however, to be applied by skilled hands and with much care, as, by the action of so long a lever, the intestine might be ruptured or serious injury done to the soft structures of the pelvis.

DEAFNESS, Diagnosis of.—Deafness is a blunting or abolition of the perception by the ear of the external world. This defect may arise in the sensorium itself, which is essentially the perceiver of sound, or in the sensory organ, which supplies to the brain the material which it transforms into a sensory perception. How this change of the physical into the physiological process is effected remains a mystery. How the collection and conduction of sonorous vibrations to the auditory sensorium are effected is, so far as surgical purposes are concerned, fairly well known, and it is with the integrity of the structures acting in these capacities that the surgeon will be required to deal.

The defect may be of such a slight character that it is not perceptible even to the patient himself, as in the cases where the range of audition is limited, or when it affects one ear only, and it has not been brought under his notice. Or it may be apparent under certain conditions only, as in cases affecting the accommodation of the ear, when it causes an inability to join in mixed conversation. In other cases the facultative loss is so great that it is apparent to all, and prevents the sufferer following the usual avocations of life, or enjoying the conversation of his fellow-beings. The cases which seek surgical aid are those in which an inconvenience is felt in the usual intercourse of life, and to these our examination will be confined.

How do we determine the degree of the defect complained of? Numerous methods have been proposed and are in use, but for practical purposes the watch, the tuning-fork, and the voice are sufficient.

The want of any index of the strength of the voice, when used as a test, prevents it being employed as a means of comparison with the observations of others, or even with the observation of the same surgeon at different times; and, although valuable in being the form of vibrations which the patient generally desires to hear best, and also in being a method which commands conclusive answers, it is much less exact than the tests by the watch and tuning-fork. As it, however, happens that there is no exact relation to be found between the ability for the hearing of speech and simple tones, and that it may increase for the one while it remains *in statu quo*, or even decreases, for the other, the voice ought to be employed by the surgeon in all cases, and more especially in those where the patient will be under observation upon different occasions by the same attendant.

In testing by speech a whisper is usually employed, and the patient, closing the opposite ear, and turning the ear to be experimented upon towards the speaker, is thus unable to assist himself by observing the motion of the lips, in repeating the words or answering the questions of the surgeon. The distance at which the patient recognises the words spoken is taken as the degree of hearing for that day. If single words be employed, care must be taken to use words containing vowels of similar tone and of equal familiarity on different occasions. The asking of several questions which have no connection with each other seems to be more practical, and as conclusive.

The acuteness of hearing is determined with the watch by causing the patient, with his eyes and opposite ear closed, to say at what moment he hears the tick of a watch brought gradually towards the ear under examination. The distance of the watch from the ear at that moment is noted, and is employed as the numerator of a fraction, the denominator of which is the number of inches at which the tick of the watch in use is heard by a normal ear. By this mode of noting the observation, a comparison can be made of the acuteness at different times and by different observers. When the patient cannot hear the watch unless it be in contact with, or pressed upon, the auricle, the numerator becomes $\underline{\text{Co}}$ or $\underline{\text{P}}$ respectively. A stop-watch is useful for verifying the statements of the observed, but, by noting repeatedly the distance at which the patient avers that he becomes cognisant of the watch-tick, the examination can be made with the usual watch. It must be remembered that in testing with a watch two particular notes only are employed, and therefore that the examination thereby is but a rough-and-ready way of giving a comparison of one ear with another.

Hitherto our examination has been confined to the acuteness of hearing of sonorous vibrations through the usual sound-conducting apparatus, while that through the cranial bones has not been in view. For determining the latter, a large tuning-fork of 512 vibrations in the second, with clamps grasping the prongs in order to destroy the harmonics of the fundamental tone, is the most convenient. But should that not be at hand, the watch will give a rough general estimate thereof, by placing the watch on different points of the head and making a comparison of the position of the cranium at which a weak watch-tick is lost, with the point on the observer's head at which the same occurs.

When a fork is employed, the examination is conducted as follows:—After causing it to vibrate, the handle is placed on some part of the patient's head, usually the mastoid process, and the number of seconds noted during which the sound can be recognised by the observer's normal ear, after the patient has ceased to hear it. This recognition may be effected in two ways, viz., by placing the fork on the mastoid, or close to the concha of the observer. The former is the usual mode, and of it we shall speak. The number of seconds from the cessation on the patient's mastoid to its cessation on the observer's, gives the loss compared with the normal ear. For example, if the observer finds that he hears through his mastoid the fork-vibrations for ten seconds after the patient has ceased to recognise them through his mastoid, the loss is noted as 'acoustic p. mastoid—10″,' and if the ages of the patient and practitioner are nearly the same, the loss is assigned to the parts beyond the conducting apparatus, but not excluding affections thereof. Should the fork not be heard by the observer on its transference to his mastoid, the acuteness is reckoned normal, unless there are obstructions in the meatus or cavity sufficient to reflect the vibrations passing outwards, and so reinforce those acting on the inner ear. But, for practical purposes, the acoustic may be recognised as normal.

In using the tuning-fork for the determination of the acuteness of hearing aerially-conducted vibrations the loss is determined in the same way as on the mastoid, care being taken to place the fork in the same position in relation to both the observed and observer's ears. It would further the diagnosis of such affections if a standard fork could be settled upon, which we could use as the denominator, as we do in the case of the watch.

It will be simple from the above methods to fairly apportion to its proper seat the cause of deafness. No affections, however severe, of the external or middle ear which are conducting apparatus alone, will prevent the recognition of sonorous vibrations sufficiently loud to be perceived by a healthy acoustic nerve through the mastoid, from reaching the internal ear of the patient through that bone. No such vibrations, however well conducted, either through the meatus or through the mastoid, can arouse an acoustic whose function is in abeyance. If a watch be heard at what has been determined to be its normal distance, the acuteness of hearing, for that note, may be taken as normal. If a fork be heard as long on the mastoid of the patient as on the mastoid of a normal ear, the internal ear may, for that note, be taken as fairly healthy. If the fork be heard to the natural extent or exceed it on the mastoid, but neither it nor the watch reach the standard determined for aerially-conducted vibrations, an affection of the external or middle ear is diagnosed. If the watch be not heard at its proper standard of distance, nor the fork to its proper extent through the mastoid, the apportioning of the amount of the defect to the external and middle ear, and to the internal ear, may be roughly made by the examination of the structures, and by noting the loss of vibrations conducted by the meatus after their perosseal recognition has ceased. Thus, if a fork, the vibrations of which are heard at the concha thirty seconds after they have ceased to be recognised on the mastoid, is heard by the patient five seconds less on the mastoid, and only ten seconds at the concha, the loss is marked as five seconds and twenty seconds respectively.

W. Laidlaw Purves.

DECUBITUS. *See* Bedsores.

DEFORMITIES, Congenital. *See* Club-Foot; Hare-Lip, &c.

DELHI BOIL or SORE.—This disease first attracted attention by its great prevalence among the British troops stationed in the city of Delhi after the mutiny of 1857. Before the mutiny the troops were garrisoned in a cantonment situated outside the city walls, and they appear there to have enjoyed an immunity from these sores. In the year 1864 as many as from forty to seventy per cent. of the men suffered from them; and the Government of India appointed a commission, of which Dr. John Murray, Inspector-General of Hospitals, was president, to investigate the nature and cause, and advise as to the prevention and cure, of this troublesome complaint. The commission submitted a long and interesting report. They found that the disease was not dependent on poverty or malaria, and that it was inoculable; associated it with the filthy state of the city, more especially with the use of impure water drawn from foul wells; and recommended sanitary improvements and the supply of river or canal water to the troops for all purposes.

Much interesting information on this and allied subjects will be found in the late Dr. Tilbury Fox's work on *Diseases of the Skin*, and in a volume published by Drs. Tilbury Fox and Farquhar in 1876, under the sanction of the Secretary of State for India, *On Certain Endemic Skin and other Diseases*.

It has been established, by the observations and researches contained in these reports and publications, that the disease known as Delhi boil or Delhi sore is by no means confined to the town of Delhi and the neighbouring villages, but prevails in other parts of Northern India.

A similar disease has been observed and described by Colville, Wortabet, and others as existing in Syria and Turkish Arabia, more particularly in the towns of Aleppo, Bagdad, and Bussorah, and other localities situated in the land of Mesopotamia—the valley of the rivers Tigris and Euphrates. It is known in these parts as the Aleppo Evil, Date Mark, and the Bouton d'Alep. The same disease has been met with at Aden. An affection apparently identical with the Indian and Arabian sores has been observed in Egypt, Morocco, and Algeria. Finally, Dr. Vandyke Carter discovered a disease which he considers to be the same as the Algerian and Syrian maladies in the island of Candia, where it has the name of Caneotica (from Canea, the capital town of the island), Bouton de Crete, Lib-lib, &c. He has carefully studied, described, and figured the sores of Algeria, Crete, and Aleppo, and advances the opinion that there is an 'essential bond of connection between the maladies of Biskra, Crete, Bagdad, Aden, Scind, and Delhi.'

Causes.—The disease is endemic, and has a very definite geography. Its causes must therefore consist in conditions and circumstances common to the localities in which it is met with. What these are has not been clearly ascertained. It prevails in towns and crowded centres of population rather than in hamlets and sparsely inhabited villages. In these its homes it attacks all classes, both sexes, and all ages indiscriminately, but seems to have a preference for new-comers and young children. It does not seem to depend on climate, for then it would be more generally distributed in town and country; but climatic conditions may, and probably do, combine with local conditions to produce it. These latter appear to be, or to be closely associated with, filth. The disease has almost disappeared from Delhi in consequence of sanitary improvements and improved water-supply (see *Report on Sanitary Measures in India in* 1873–74, and Drs. Lewis and Cunningham's report), and it lingered longer among the native troops and the native inhabitants of Delhi, who continued to draw their water from wells, than among European troops for whom river-water was provided. The well-water of Delhi has been found to be very impure, exceedingly hard, and to contain large quantities of nitrates and nitrites. The water of Biskra is also said to have been extremely impure; but here also a similar effect has followed similar changes in sanitation. In Aleppo and Bagdad the disease is ascribed to the use of impure river-water, and those resorting to clean wells are said to remain free from it. In Algeria the disease presents a marked seasonal character, attacks being most common in November and December; but in other places this feature is not so well marked. Occasionally, according to Carter, Aleppo Evil presents an epidemic character; and there is strong evidence that it was imported into Candia in the year 1827 by Turkish troops from Aleppo and Damascus who were sent to quell an insurrection in the island. It took root in Canea, and spread thence to other places. The sore is undoubtedly inoculable; this has been proved by experiment in India and Algeria, and the Jews of Bagdad practise inoculation of children. The disease is not contagious in the ordinary sense, but it seems to be communicable in a manner not yet determined. Nor does it appear to be hereditary. One attack is not protective from subsequent attacks, but repeated attacks are not the rule, and old residents appear to enjoy comparative immunity. Dogs and horses are said to contract the disease. What the intimate or immediate cause of the disease is has not been discovered. It has been ascribed to depraved nutrition of the body due to climatic influences, and considered to be 'a local manifestation of a cachectic condition due to residence in unhealthy localities' (Tilbury Fox); but these sores attack persons to all appearance in good health, and in other than endemic localities, where people also manifest climatic cachexia, they are not known. The fact that the most exposed parts of the body—arms and hands, face and legs—are those most liable to attack, points to a local causation. The disease has been attributed to the entrance of parasites through the pores of the skin and to poisonous material conveyed by mosquitoes and flies; but of these views no positive proof has been advanced.

Pathology.—In the language of modern pathology the disease belongs to the category of infective granulomata. Drs. Lewis and Cunningham found, as a result of very careful study, that its microscopic characters were identical with those of lupus as described by Virchow and others, and Carter's descriptions and plates support this view, which is also that of Geber, who investigated the Aleppo button. The skin is found to be infiltrated with lymphoid cells, which are found more abundantly near the vessels, glands, and lymphatics, and, gradually increasing in number, supplant the elements of the tissue. The features of the disease depend on the number and fate of these cells. Among them, miliary particles of an epithelial character and origin are found, some of them being altered hair-bulbs and impacted gland-ducts. The disease consists, in fact, of a conversion of the true skin into granulation-tissue, the epithelium being first increased and then shed, and the disintegration of the cells giving rise to breach of surface, which is eventually repaired by a process of granulation and cicatrisation. The cells appear to possess infective properties, but no structure of a parasitic kind has as yet been discovered in the morbid tissue. The new structure has a definite lifetime, and if the surrounding parts possess sufficient vital resistance limitation takes place and repair ensues. If the vital resistance is weak, from general ill-health, limitation does not occur so soon or so completely; new areas of skin are invaded, and the disease spreads in the manner indicated by the term 'serpiginous.'

Symptoms and diagnosis.—The disease in a well-marked case presents several phases or stages, which may be called the stages of (1) infiltration, (2) ulceration and incrustation, and (3) repair. It commences as a small, hard, itchy papule or pimple resembling a mosquito-bite. A few dilated vessels may be seen converging to the centre of this spot, which presently enlarges and becomes smooth, raised, dusky, and shining. Ridges of smooth swollen skin radiate from this elevation, or new spots appear in its vicinity. The affected area pits on pressure, and a stinging sensation is experienced on touching it. The hair-bulbs are specially involved, and present the appearance of minute, yellowish points in the glazed, dusky, red material. Presently the epithelium is shed; a viscid ichor exudes from the surface, which becomes covered by a crust. As the disease extends the crust enlarges, and at the centre breach of surface takes place, and pus and disintegrated tissue assist in forming the crust, which may exhibit cracks emitting a sanious or puriform fluid. On removal of the crust an ulcer is revealed, with hard edges and a red, flabby, irregular surface, covered with fungoid granulations that bleed freely. Eventually cicatrisation commences at the centre and proceeds towards the circumference. The outer infiltrated ring of the sore undergoes resolution, and a smooth, depressed, reddish-brown cicatrix, with sharp edges, remains. No contraction results from the loss of tissue, which does not involve the subcutaneous areolar structure. This is a description of a typical case; but in mild instances of the disease no breach of surface or ulceration occurs, the granulation material undergoing in part disintegration and in part organisation into cicatricial tissue. In other cases the process is complicated by suppuration, a small, deep, punched-out abscess forming in the centre and giving rise to a hollow ulcer, or these ulcers may be multiple. In other cases the course of the disease may be materially modified by the application of caustics and irritating agents.

The progress of the disease is slow and protracted, and occupies from six to twelve months from first to last. The parts of the body most commonly attacked are the forearms—the back and ulnar aspect by preference—the wrist and front of the forearm, the elbows, the hands, the neck and face, the knees, legs, and feet. The trunk is very rarely affected. Persons arriving at a place where the disease is endemic do not contract it for several months, and the sore may appear many months after leaving the locality, so that there would seem to be a long period of incubation. The neighbouring glands are not affected except when the sore is irritated, and there is no indication of any constitutional change accompanying the local disease.

The diagnosis is not difficult. Residence in a locality where the disease is known to prevail, and careful study of the features of the sore as above described, suffice to distinguish it from any other cutaneous disease except lupus, with which many competent authorities consider it identical. Spreading serpiginous ulcerations sometimes appear on the genitals and groins as a result of chancroid which present features somewhat resembling the Oriental sore; but these are generally more extensive and protracted, and show little or no disposition to undergo spontaneous cure. The locality of these ulcers, and the absence of a history of residence in a place where the sore is endemic, aid in establishing a distinction. The only other affections for which this sore might be mistaken are the syphilitic and pseudo-syphilitic granulomata, such as the frambœsia of the West Indies and the Parangi disease of Ceylon; but the eruption in these cases is more extensive, the severity of the disease greater, and constitutional cachexia more apt to accompany it. It only remains to add that, in its endemic haunts, ordinary wounds, scratches, or abrasions may take on the features of the specific sore.

Treatment.—The best *preventive* treatment is obviously removal from the locality where the sore is endemic. Next to that, attention to general sanitation, and more especially the use of pure water, appear, from the evidence above referred to, to exercise a decided influence over the prevalence and development of the disease. As regards local or curative treatment, destruction of the indurated papule or tubercle in its early stages, by means of caustics, is allowed, by all who have had an opportunity of testing it, to be a thoroughly effective means of stopping its progress and minimising suffering and loss of tissue. Various agents have been employed for this purpose—principally nitric and carbolic acids, potassa fusa and strong liquor potassæ, and nitrate of silver. A preliminary incision has been recommended, to admit of readier access of the caustic to the doomed tissue. Even after ulceration has been established, the destructive treatment is considered by some authorities the best, as saving time and tissue. Care must be taken, however, in the later stages that the cure is not worse than the disease. Scraping away the neoplasm with Volkmann's sharp spoon, or the cautious use of chloride of zinc paste, would be preferable to the stronger caustics in this stage. Irritating and stimulating applications of all kinds, such as the tinctures of iodine and iron, preparations of zinc, copper, and mercury, have been used without effect. They probably do more harm than good by weakening the vital resistance of the surrounding tissues. Soothing poultices, lotions, and ointments have also been employed, with more sense and success. It is very important, by means of tonics and diet, to improve the general health and intensify the vital resistance of the organism generally, and of the tissues adjoining the sore specially. K. McLeod.

DELIRIUM TREMENS may come under the notice of the surgeon as an independent complaint; but the cases dealt with in this article are those in which the symptoms supervene upon, and are the consequence of, a surgical injury, occurring in a person suffering from the effects of alcoholic excess. It is a well-known fact that intemperate individuals are unfavourable subjects for any injury or operation, and one direction in which this is revealed is in their liability to delirium tremens. In the writer's experience at the Liverpool Northern Hospital the symptoms did not come on in persons who were injured while drunk, but rather in those who were habitually intemperate, but by no means always to such an extent that they became intoxicated. Indeed, in some instances the patients would strenuously resent the charge that they were intemperate, because they were never drunk, and never lost a day's work. The kind of injury which is followed by delirium tremens varies, and it may be in itself of no danger, or even very trivial, such as a simple fracture or sprain, or a superficial wound. How far the suddenly enforced abstinence from alcoholic drinks may account for the development of delirium tremens is a matter of dispute; but there does not appear to be any real danger from this cause if the patient is properly supported in other ways. In some instances bad living, anxiety, injurious habits—such as excessive smoking—or previous illness, act as predisposing causes.

Symptoms and Diagnosis.—The more characteristic symptoms of delirium tremens may set in, in surgical cases, either rapidly and without any warning, or more gradually, being preceded by premonitory symptoms, such as disturbed sleep or sleeplessness; restlessness and tremulousness; mental agitation and confusion, with lowness of spirits and foreboding of ill; anorexia and disorder of the alimentary canal, with foul tremulous tongue and offensive breath; a quick but soft and compressible pulse; and more or less free perspiration. The actual symptoms usually appear within three or four days from the date of the injury, and often supervene during the night. The more striking of these symptoms, connected with the nervous system, may be summed up as absolute sleeplessness; mental disorder, with a peculiar form of delirium; and marked muscular trembling, combined with restlessness. The mental condition is one of mingled confusion, excitement and agitation, irritability, sense of dread, and suspicion. The delirium is usually of a busy character, and attended with various delusions, illusions, and hallucinations, of a strange and often horrible nature, which are generally transient and changeable, but occasionally fixed. Thus, the patient fancies he sees hideous objects, hears strange sounds, or feels insects crawling over him. He has an anxious, wandering expression, and is suspicious and distrustful of all who come near him. It may be possible to attract his attention for a moment, so that he will answer a question or do some act which is requested, but he speedily wanders off again. His own ideas prompt him to perform various actions, but there is an evident want of control, with unsteadiness of purpose. In some cases the delirium is of a violent character, and the patient tries to injure himself or others, or to tear the dressings off wounds or the splints off fractures. In other instances it either is from the first, or very speedily becomes, of a low and muttering type. There is marked trembling, which is especially evident in the hands and tongue.

There is usually little or no fever, but the patient is bathed in perspiration, while the pulse continues rapid and wanting in tone. In bad cases it may become dicrotic, as revealed by the sphygmograph. Occasionally marked pyrexia is observed, and the temperature may reach a considerable height. If the patient is violent, he becomes much exhausted after the fits of exertion. Should the symptoms not abate, and sleep be obtained, the tendency is towards rapid prostration and adynamia, and the patient dies from exhaustion or in a comatose state. Complications, especially pneumonia, may also supervene and hasten the fatal issue.

Delirium tremens, in surgical cases, has to be diagnosed from traumatic delirium which is independent of alcoholic excess; and from acute inflammation of the brain or its membranes. Attention to the history and symptoms will generally render the diagnosis sufficiently clear.

Treatment.—The treatment of cases of delirium tremens in surgical practice must be conducted on similar principles to those which are adopted in other cases. General management is highly important. The patient must be kept as quiet as possible, undisturbed by friends or others; at the same time being constantly watched by a competent nurse, one who combines the necessary firmness of purpose with gentleness of manner. He should, as much as possible, be humoured and influenced judiciously, without being opposed or physically coerced. Special care must be taken to prevent him from injuring himself, and for this purpose two or more attendants may be necessary. It is only in violent cases, where the proper amount of help cannot be obtained, that restraint by means of the strait-waistcoat is admissible; but still it may be imperatively demanded under such circumstances, otherwise the patient may convert a simple injury into a very serious one.

Attention to diet is another most important indication. A free supply of nutritious, easily assimilated, liquid articles of food is demanded, to be administered at frequent intervals, by night as well as by day. They may be previously digested by the peptonising agents now in use. Not uncommonly it is a difficult matter to get patients to take food, but much may be done by judicious coaxing. If, however, the difficulty is great, nutrient enemata, with some digestant, must be employed at regular intervals. As regards stimulants, whether they should be given or not, and in what quantities, must be determined by the circumstances of each case, and this matter always requires careful consideration. In many instances undoubtedly no stimulant should be given; but in others of a low type, or attended with much exhaustion, some kind of stimulant must be allowed, and it has been recommended to give that one to which the patient is accustomed. There are, moreover, other circumstances affecting surgical cases which may determine the question of the use of stimulants, apart from the delirium.

With regard to the use of medicines, these are often required in order to procure sleep and calm the cerebral excitement, but they must be given with due caution. In surgical cases the subcutaneous injection of morphia (gr. $\frac{1}{4}$ to gr. $\frac{1}{2}$), is the best remedy to employ as a rule, repeated at more or less frequent intervals according to circumstances. Opium in a solid form, or the tincture; chloral hydrate (gr. xx.—xl.), and bromides, are also useful agents. Chloral hydrate and a bromide together form a valuable combination. How far it is desirable to push drugs of this class must depend upon the circumstances of each case, and their administration needs constant watching. It may be an imperative necessity to compel sleep at any risk, and in one case which came under his notice the writer believes that the attainment of this object, by the use of large doses of morphia, was the means of saving the patient's life. Chloroform may be serviceable as a temporary aid, in relieving violent excitement, enabling some surgical procedure to be carried on, or an enema to be administered. Among other medicinal agents recommended under certain circumstances, may be mentioned tincture of digitalis in full doses, tartar emetic (when there is much excitement), and capsicum.

The bowels should be opened from time to time by the aid of a saline purgative. Should adynamic symptoms set in, ammonia with bark and ether, and similar remedies, may be administered.

Frederick T. Roberts.

DE MORGAN'S SPLINT, for fracture of the thigh, is a long splint, which is applied to the sound side of the body, and which reaches from the axilla to well beyond the foot; from its lower end a crossbar passes at right angles towards the other foot. An extension apparatus is fixed to the injured limb, and the cord connected with it passes first longitudinally to the extremity of the crossbar, where there is a pulley, round which it passes to a second pulley at the end of the long splint, and thence up the outer side of the latter to an elastic accumulator, by means of which the proper amount of extension can be given to the limb. Bilton Pollard.

DENTIGEROUS CYSTS.—The development of *cysts* in connection with uncut teeth is a subject of great practical importance to the surgeon, since mistakes in the diagnosis and treatment of these cases are far from rare.

Dentigerous cysts may occur in either jaw, a tumour being gradually formed, the growth of which is slow, and for the most part painless.

A careful examination of the neighbouring teeth will be the best guide to a correct diagnosis, for if a tooth be absent, or if, as sometimes happens, a temporary tooth occupy the position of a permanent one, the tumour in all probability is a dentigerous cyst, and no mutilating operation should be undertaken without first opening up the tumour to discover its nature.

Dentigerous cysts arise in connexion with teeth which, from some cause, have remained within the jaw, and have undergone a certain amount of irritation. They are most commonly connected with the permanent teeth; though the writer has met with a cyst in a boy of four, in whom a temporary canine tooth was wanting, and on cutting into the cyst, extracted seven small irregular nodules of dentine and enamel. Frequently the tooth in fault is inverted, but often there is nothing to explain the formation of the cyst, which is apparently due to an increase in the quantity of the small amount of fluid ordinarily found in the tooth-sac, after the completion of the development of the enamel.

The cyst-wall is usually too dense to give rise to the crackling so characteristic of the presence of fluid within, and is lined by a thick vascular membrane. Usually the tooth projects through this membrane; but a case has been met with in which a large cyst of the lower jaw was carefully searched in vain for a tooth, which, however, made its appearance some weeks after, when the membrane had been to a great extent destroyed by suppuration. Dentigerous cysts have been mistaken for solid growths on many occasions, one of the most remarkable specimens of the kind being one side of the lower jaw, removed from a girl of thirteen, in error, by the late Mr. Fearn, and now in the museum of the Royal College of Surgeons of England. Here the two plates of the lower jaw are expanded from the angle on the left to beyond the symphysis on the right side, forming a bony cyst, the cavity of which is lined with a thick vascular membrane, through which a well-formed permanent canine tooth projects.

The *treatment* of these cases of dentigerous cyst is sufficiently simple, when once a diagnosis has been made by an exploratory puncture. The removal of a portion of the cyst-wall, so as to allow of a search for, and the removal of, the hidden tooth is all that is necessary, the cyst-wall rapidly falling in so soon as a free vent for the contained fluid is secured.

Occasionally the contents of these cysts have suppurated before being opened, and in all cases care should be taken to use antiseptic lotions, and to ensure cleanliness by syringing. Cysts in connexion with fully-developed teeth undoubtedly occur, although possibly some of the so-called cysts are nothing more than abscess-sacs, which follow the fangs to which they are attached when extracted. *See* ANTRUM, Diseases of the. CHRISTOPHER HEATH.

DENTITION.—Writers on the diseases of children have been accustomed to lay at the door of teething a great variety of ailments, ranging from minor disturbances of the digestive tract to convulsions and marasmus. Why a normal developmental process should be so often a pathological one has puzzled many more recent authorities, and there is a growing disbelief in the ill-effects of 'teething.' So far as surgical treatment goes, it is limited to the lancing of the gums, which, if done at all, should be done freely, the tense gum being divided by a linear incision in the case of incisors and by a crucial incision in the case of molars. This will relieve some degree of worry and discomfort, if it does no more. Of more interest to the surgeon are the deformities of the teeth induced by constitutional conditions during the period of formation of the permanent teeth, which commences nearly coincidently with the time of birth. Congenital syphilis has been shown to induce a stunting of the first-formed portions of the teeth, so that the tips are contracted in all dimensions, whilst the bases of the crowns, formed later, are of normal size. Thus the incisors come to be peg-shaped, with a semi-lunar notch from side to side; the canines short and contracted at their points; and the first permanent molars have stunted cusps, the second and third molars being better formed, as their calcification does not commence till a later period.

Teeth with craggy honeycombed enamel are believed by Mr. Hutchinson to owe their deformity to the administration of mercury in infancy; it is certain that they are often found in children who have suffered from convulsions, but it is not fully established that they may not arise in any ill-nourished child independently of mercury, or of any form of stomatitis. CHARLES TOMES.

DESAULT'S LONG SPLINT for the thigh differs from that of LISTON in having a footpiece for the outer side of the foot in place of the notched extremity of the latter splint; it is also slightly hollowed, so as to fit the limb more comfortably, and it increases in width gradually from the footpiece to the upper end. The foot is attached to the footpiece, and counter-extension is maintained by means of a perineal band fixed to a notch at the upper end of the splint. The spica and body bandages are applied as usual. BILTON POLLARD.

DIABETES. — Certain surgical disorders occur in the course of diabetes with sufficient frequency and regularity to entitle them to be considered, not merely as accidental complications, but as in causal connection with it, or in some way or other dependent on it. They may be either purely functional or inflammatory, the general nutrition being so much impaired that the tissues break down into pus, or even slough and become gangrenous under altogether exceptional causes. The pruritus that is so exceedingly common, especially in the later stages, is an example of the first of these. All through the course of diabetes the skin is dry and harsh (like the dryness of the mouth and fauces, probably from purely physical reasons), very often scurfy and irritable; in the neighbourhood of the genital organs, especially of the female, this is so marked and so frequent that in all cases of severe pruritus it is necessary to examine the urine for sugar.

Boils and carbuncles are instances of the latter class. These affections stand in some peculiar relation to diabetes, for cases have been recorded in which, while suffering from an outbreak, otherwise healthy persons have passed considerable quantities of sugar in their urine. Boils occur most often in the earlier stages, and may come out in successive crops for a long period; carbuncles rarely till the disease is far advanced, and then the prognosis becomes exceedingly grave. Chronic urticaria, psoriasis, impetigo (Kaposi), and paronychia have also been observed, but not with the same regularity.

Affections of the eye are not rare. Diabetic cataract, arising from the defective nutrition of the lens, has long been known. Unless the case is severe it does not, as a rule, make its appearance until late in the course of the disease, so that operation for it, though sometimes successful, is seldom attempted. One eye is usually attacked first, and then later the second becomes involved, but it is rare for it to be complete in both long before the patient's death. Amblyopia, either temporary and recurring, varying in its degree with the progress of the general symptoms, or permanent and rapidly becoming worse, is probably dependent on a similar impairment in nutrition of the retina, and the paresis of the muscles of accommodation that is met with occasionally is probably to be explained in the same general way. In one or two instances hæmorrhagic retinitis independently of albuminuria has been observed.

Gangrene of exposed parts and of the extremities, resembling the ordinary senile form but more rapid in its action and always moist, accompanied by sloughing inflammation, is not uncommon as the immediate cause of the fatal issue in diabetes. The circulation is so feeble, the character of the blood so profoundly altered, and the vital energy of the tissues so depressed, that the slightest injury, especially of the foot, may suffice to induce it. For fear of this, from the extreme susceptibility to shock and the great tendency to secondary hæmorrhage, operations, unless absolutely essential, are rarely undertaken in diabetic patients. All wounds, even slight injuries, are repaired with great difficulty and are very prone to slough.

Glycosuria, sometimes only transient, sometimes permanent and indistinguishable from diabetes, is an occasional sequela of injuries. The former is not uncommon after prolonged narcosis, and may probably be attributed to the derangement of the circulation or the action of vasomotor nerves; the latter is more rare and difficult of explanation. Injuries of the head, general concussion of the whole body, or of the spine alone, afford the best known examples, but it has also been observed after blows on the abdomen, or over the kidneys, fractures of vertebræ, violent and prolonged muscular exertion, and even after burns; sometimes setting in within a few hours, sometimes only first noticed after months. Brown-Séquard is of opinion that under these conditions it must be of reflex origin.

C. MANSELL MOULLIN.

DIAPHRAGMATIC HERNIA. — This form of rupture possesses little practical interest. Out of 250 cases collected by Leichtenstern, the condition was diagnosed in 5 only. Even when diagnosed, the hernia is not amenable to treatment. Two general forms are described. In one the viscus that is protruded through the diaphragm from the abdomen into the thorax is contained in a sac formed either by the peritoneum or pleura, or by both. This is the true hernia. In the other there is simply a hole or rent in the diaphragm, and no sac. This is the false hernia. The false is more common than the true, in the proportion of 10 to 1. Some of the herniæ are congenital, and depend upon arrest of fœtal development, whereby the partition between the thorax and abdomen is imperfectly formed. Others are acquired, and depend mainly upon injuries that lacerate the diaphragm, such as stabs, gun-shot wounds, fractures of ribs. The acquired forms are much more common than the congenital. The hernia is more often on the left side than the right, in the proportion of 5 to 1. The abnormal aperture is more often in the muscular that in the tendinous parts of the diaphragm. Herniæ not infrequently occur through a gap close to the xiphoid cartilage, and between the costal and sternal portions of the diaphragm. The rupture has passed through the œsophageal opening, but never through that for the aorta or the vena cava.

The contents are most often the stomach, then the tranverse colon, then the small intestines. Next in order of frequency come the spleen, liver, pancreas, and kidneys (Leichtenstern). The hernia may cause no symptoms, or it may end fatally almost directly after its formation, or it may pass into a chronic state, giving only occasional trouble. The affection is very difficult to diagnose. In marked cases there is prominence of one half of the chest, a displacement of the heart to the right side, a tympanitic area in the thorax, with an absence there of respiratory sounds and vocal fremitus. There is pain in the chest and abdomen, together with attacks of dyspnœa, especially after eating or straining, constipation, dyspepsia, &c.

Frederick Treves.

DIGITAL COMPRESSION. *See* Aneurism; Femoral Aneurism.

DIPHTHERIA OF WOUNDS.—True diphtheria of wounds is a very rare affection. The skin is far less liable than mucous membrane to the disease, and, when covered by normal epidermis, is never attacked. Slight excoriations of skin, leech-bites, &c., are most liable, but granulating surfaces are not exempt. Direct contact may produce it; e.g. the introduction of a cut finger into the throat of a child with diphtheria has led to the local development of diphtheria, attended by severe constitutional symptoms, and followed by paralysis. In rare cases, the disease has attacked excoriations, or skin-lesions such as favus, by infection, has led to diphtheria of the air-passages, and has been communicated to others with fatal results. The local process strongly resembles the disease miscalled 'hospital' gangrene, and is usually associated with phagedæna; but, strangely enough, tracheotomy wounds do not seem to be attacked.

Symptoms.—The skin attacked becomes red and swollen; an infiltrated, highly inflammatory area extends around, and serous fetid discharge escapes. The edges of the wound are raised up; vesicles form around the margin, break with discharge of fetid serum, coalesce, and develop into fresh sores. The surface is covered with thick, membranous, semi-transparent rinds like wet washleather, which adhere deeply but can be peeled off, though they are rapidly reproduced. The infiltrated tissues break down in shreds, but the sloughing does not usually extend to any great depth. The history of a possible contagion or infection will confirm the diagnosis.

Treatment.—The local treatment consists in peeling or scraping off the rinds, and then applying caustics. Solid caustics are usually best, such as potassa fusa diluted to half its strength with caustic lime, applied freely to the base and edges of the wound; but constant irrigation, which must be persisted in for a considerable period, answers well at times. Acid nitrate of mercury in solution, or strong tincture of iodine, has been used with benefit. The freest ventilation should be accorded, some stimulants, and the most nourishing diet possible. Salicylated cotton-wool should replace sponges, and be burnt, with all dressings, directly after use. Every precaution must be taken to prevent infection of mucous membrane, especially of the mouth, from the wound. Conversely, it must be remembered that in diphtheritic cases excoriations of the skin, and especially blisters, are liable to be attacked.

A more common, but still rare (in this country), affection of wounds resembles the above in its local symptoms, but is unconnected with true diphtheria, and will not give rise to it. It attacks the same class of lesions, especially granulating surfaces. A buff-coloured exudation covers the wound like a rind: it may be peeled off easily, and the raw surface, if treated with a stick of nitrate of silver or tincture of iodine, will usually soon heal. The local disease may remain long stationary or spread extensively, but it remains local. The granulations may slough, and then the condition simulates true diphtheria of wounds. If there is doubt about the diagnosis, it should be regarded as the severer form. The local treatment would be the same.

C. T. Dent.

DIRECTORS are blunt instruments, grooved to allow a bistoury to pass along them, and thus ensure an incision being made in the right direction. A steel director is useful for dissection among veins, as in tying the subclavian artery, but should never be employed where an artery is superficial and can be readily exposed with the scalpel. A German-silver director, especially if probe-pointed, is valuable in operating for fistula in ano, because it can be curved as required. A broad steel director is often employed in dividing the stricture of a strangulated hernia.

DISLOCATIONS.—A dislocation is a displacement of the articular surface of a bone from the position it normally occupies in a joint. Such displacement is rendered possible by giving way of the ligaments which maintain the bones in apposition, and it is frequently associated with laceration of muscles and contusion of the soft parts in the vicinity. When the injury producing the dislocation is severe, other complications may be present, such as paralysis from pressure upon, or rupture of, large nerve-trunks, and tearing of the main artery or vein of the limb. Proportionately, however, to the number of dislocations, such complications are very infrequent. Some dislocations, as those of the ankle and elbow, are not uncommonly associated with fracture of bone, whilst others, as those of the hip and shoulder, are very rarely complicated with fracture.

Dislocations are divided according to their origin into *congenital*, *pathological*, and *traumatic*.

Congenital dislocations are met with at birth, and the mode in which they are produced is a matter of conjecture. *See* Congenital Dislocations.

Pathological dislocations are such as follow disease or inflammation of joints, and will be treated of under the heading of joint-disease. *See* Joints, Diseases of.

Traumatic dislocations, or those which are produced by violence, constitute by far the greater number, and are of chief importance to the surgeon. The violence which causes the dislocation may be *direct*, that is, applied to the bone in the immediate vicinity of the joint, as when a person falls on his shoulder and drives the head of his humerus out of the glenoid cavity; or *indirect*, when the force is transmitted from a distance—for example, a dislocation of the elbow caused by a fall on the palm of the hand. Apart from external violence, bones are occasionally dislocated as the result of sudden *muscular action*. This is more likely to occur if the joint has been previously the subject of dislocation from injury. Many cases are on record where the humerus has been dislocated at the shoulder by muscular action, the result of some sudden violent exertion, such as throwing a cricket-ball or wielding a club; and a case is mentioned by Holmes of a patient who dislocated his shoulder by suddenly turning when lying in bed. Another joint which is liable to be dislocated by muscular action is that of the lower jaw. The patella is liable to be dislocated outwards by the action of the rectus muscle, and this is especially the case in knock-kneed persons, because the anterior prominence of the external condyle, which in normal joints serves to counteract the oblique pull of the rectus, is no longer efficient for that purpose when the deformity renders the direction of the force still more oblique. Complete primary dislocation from muscular action, is, however, a rare accident, and very exceptional at any other joints than those mentioned. Dislocations occurring in partially paralysed limbs from irregular muscular action, and those resulting from disease, have sometimes been incorrectly spoken of as *spontaneous dislocations*.

The effect of muscular action is occasionally found to change the character of a dislocation. Thus a subglenoid dislocation of the humerus may be converted into a subcoracoid, and a sciatic dislocation of the femur into one on the dorsum ilii. Such dislocations are spoken of as *consecutive*, to distinguish them from those resulting immediately from the injury, which are called *primary*. The surgeon, by ill-directed efforts to reduce a displaced bone, may bring about a consecutive or secondary dislocation. The writer once saw all the regular dislocations of the hip produced, in succession, by attempts made to reduce a dislocation on the dorsum ilii, before the head of the bone was finally lodged in the acetabulum.

A dislocation is spoken of as *incomplete* or *partial* when, the capsule being only partially torn, or the ligaments being of abnormal length, the articular surface of one bone is not completely displaced from the articular surface of the other. Partial dislocations frequently depend on a general laxity of ligaments, such as is artificially produced in those trained to become clowns and tumblers. These persons acquire the power of distorting their joints in a manner closely resembling dislocations, but without tearing their ligaments, which are unduly elongated. These are, however, not true dislocations, but abnormal movements permitted by abnormal ligaments. Partial dislocations are very readily reduced. When occurring as the result of injury at the shoulder or hip, the ligaments are partially torn, and the head rests on the margin of the glenoid or cotyloid ligament, which may cause an indentation in the articular cartilage of the displaced bone. Arthrodial joints are more liable than others to be partially dislocated. When the displacement is lateral at the knee or ankle, the dislocation is generally incomplete, and when at the elbow not infrequently so.

As with fractures, dislocations may be *compound* or *simple*, the word ‘compound’ being used to indicate that the skin is torn over the joint, and its interior exposed to the atmosphere. Those joints which are covered in by muscles, as the hip and shoulder, are far less liable to compound dislocation than joints such as the ankle, wrist, and elbow, which have little more than skin to cover them. A compound dislocation is a very serious but not necessarily fatal accident. The danger lies in the fever, suppuration, and septicæmia which may follow acute traumatic arthritis; but if care be taken to thoroughly cleanse and purify the wound, and afterwards to keep it septic, little or no fever may follow, and the joint may recover even without limitation of movement. The writer has seen all the heads of the metacarpal bones of the fingers dislocated through a transverse wound in the palm, the result of a fall on the fingers, yet the patient recovered without any loss of power or motion in the hand. Compound dislocations are frequently associated with severe laceration of the skin and soft parts, and in these cases, as well as in those where the bones are splintered or the vessels damaged, it may be necessary to amputate the limb without delay. It is often a difficult question to decide, and one of great gravity, whether in the case of some compound dislocation an attempt to save the limb is advisable. Fibrous or bony ankylosis may be expected to result, should suppuration follow the injury.

Predisposing causes.—Dislocations from violence are rare at the two extremes of life. In children, injuries near joints are apt to produce separations of epiphyses; in old persons, fractures. Adult males, from exposure in their occupations, are more liable than females to dislocations. Paralysed limbs are more prone to dislocation than sound, and persons of weak muscular system than those who are strong. As illustrating the power of the muscles in supporting the joints, Astley Cooper cites the execution of Damien, who was sentenced to dismemberment. Four horses pulling for fifty minutes failed to tear away his limbs, which only yielded when the soft structures were divided. Some joints are more liable to dislocation than others, and the shoulder-joint, from its exposed situation and shallow socket, is more often dislocated than any other.

General signs, symptoms, and diagnosis of dislocation.—As the joints of the extremities are those which furnish nearly all the instances of dislocation, and as a symmetrical displacement is of extremely rare occurrence, a comparison of the sound limb with the one injured will generally afford immediate evidence of deformity when a dislocation has taken place. An experienced eye will detect the loss of contour in a moment, and a surgeon may often feel certain in his diagnosis before touching the patient. The angular appearance of the shoulder resulting from a dislocation is so characteristic, that a diagnosis by sight will often prove correct. Again, the position of the limb may be very suggestive of dislocation, as in dorsal dislocations of the hip, when the limb is shortened and adducted, so as to lie in front of the other; and as in the commoner dislocations of the shoulder, when the elbow projects from the side. There are, then, two signs of dislocation which may be detected by the eye, viz. (1) a deformed appearance of the joint, and (2) a peculiar position of the limb. The patient himself experiences severe pain in the injured joint, and a loss of voluntary movement.

These two symptoms are both present, though to a less extent, in cases of sprain. But in the case of dislocation there is a mechanical impediment to the natural movements, which will become more evident when an attempt is made to produce passive motion. A limitation of the normal movements is an important sign of dislocation. On the other hand, movements before impossible may, from the laceration of ligaments, become capable of being produced; thus a ginglymoid joint may, after dislocation, admit of lateral movement. But fixation is a far more constant and important sign than the occurrence of any new movement. When a careful examination is made, an abnormal projection, caused either by the bone displaced or that from which it has been dislodged, will almost certainly be felt, even if there be no deformity evident to the eye. Manipulation will further determine the absence of crepitus, and thus distinguish the injury from a fracture near the joint. A certain amount of synovial crepitus, from effusion of lymph and serum into the tendon-sheaths about the joints, is common after a dislocation, but this is easily distinguished from bone-grating. Another sign arrived at by comparison of one limb with its fellow is an alteration in the length of the injured extremity. Most frequently the dislocated member is rendered shorter, but in some cases, as in subglenoid dislocation of the shoulder, and thyroid dislocation of the hip, there is lengthening.

Besides the knowledge obtained by measuring the length of the two limbs, much information may be obtained by comparing the difference in the distances between two bony points in the sound and in the injured limb. Thus, the distance between the internal condyle of the humerus and the tip of the olecranon is unaltered in a case of supra-condyloid fracture of the humerus, whilst in dislocation backwards of the bones of the forearm this measurement is increased. There is greater tension in the muscles about a joint when a dislocation has taken place, than when there is a fracture; and a dislocation is reduced with a sudden jerk, and when reduced does not readily recur; whereas the deformity of a fracture disappears gradually under extension, and often has a tendency to be reproduced by muscular action immediately the extension is relaxed.

General treatment of dislocation.—It is important that the displaced bone should be reduced to its normal position in the joint with as little delay as possible, in order to limit the inflammatory effusion excited by its presence among the soft tissues, and in order that repair may at once proceed. Before discussing the methods of treatment, it may be well to consider the principal *obstacles to reduction.* First among these is muscular contraction—a fact readily proved by noting the ease with which a dislocation is reduced in a paralysed limb, and in a person under the influence of chloroform, or in a case of syncope. The capsule or ligaments of a joint may, in some instances, cause difficulty in reduction; thus, in the case of an enarthrodial joint, the head of the bone may not lie near the aperture through which it escaped, and in the case of a ginglymoid joint the strong lateral ligaments may escape laceration, and prevent the return of the end of the bone to its position between them. The intervention of a tendon between the joint-surfaces is a rarer, but even more serious, obstacle to reduction. It sometimes happens in the case of subastragaloid dislocation of the foot.

The complication of a fracture with dislocation may render reduction extremely difficult, or even impossible; as, for instance, where fracture of the neck of the femur complicates dislocation of the hip-joint. Happily such cases are extremely rare. The natural prominences around a joint may be found in certain instances to interfere with reduction; thus the coronoid process of the ulna forms an obstacle to reduction in dislocation backwards at the elbow, and the eminentia articularis of the temporal bone in dislocation of the lower jaw. The indications for treatment are to relax the opposing muscles or to overcome their opposition by extension; to manipulate the limb in such a manner as to return the displaced bone through the aperture in the capsule made by its exit; and to divide subcutaneously any ligament or tendon whose interference with reduction does not yield to properly applied extension or manipulation.

To overcome the resistance of the muscles, surgeons, before the days of anæsthetics, resorted to many expedients which would be regarded at the present time as barbarous. Nauseating doses of antimony or tobacco, hot baths, and bleeding till syncope was induced, were the favourite remedies to produce a constitutional effect; and then powerful pulleys were used to bring the bone into its place. By placing the patient under an anæsthetic, both voluntary and reflex muscular action are overcome, so that the surgeon is free to manipulate or extend the limb without exciting resistance or causing pain. It is only in the case of dislocations of long standing that he is ever likely to resort to mechanical aid; and then, if the patient be insensible, he must proceed with the greatest caution.

When a dislocation has been reduced, bandages or splints should be used to retain it in position till a certain amount of repair has been effected. At the same time, cold should be applied, first to check extravasation of blood and afterwards to allay inflammation. If the patient be confined to bed this is best done with an ice-bag or Leiter's coil placed over the joint; if he be allowed to walk about, evaporating lotions, containing ether or spirit, may be applied on lint. The joint should not be kept fixed longer than a fortnight or three weeks, lest difficulties in regaining movement should result from the formation of adhesions. Passive movements should be first commenced, and afterwards the voluntary be gradually encouraged. Friction, stimulating liniments, cold affusion, and galvanism may be employed, with benefit, to stimulate the muscles and absorbents of the part and assist in the recovery of movement.

Compound and Complicated Dislocations, Treatment of.—A compound dislocation—by which is understood one in which the articular end of a bone protrudes through the skin, or one where there is an open wound leading down to the displaced articular surface—offers grave considerations to the surgeon. Early in this century it was the rule to amputate in all such cases. Before the introduction of antiseptics, however, surgeons had discovered that by rigid cleanliness, rest, and free drainage, many of the limbs thus damaged might be saved. Still, the danger to life from prolonged suppuration, erysipelas, or septicæmia, was great. The stricter details of antiseptic surgery have done much to extend conservative surgery in this field. Each case is now treated on its own merits, and the question of amputation is decided by the accompanying complications. Severe laceration of soft parts and rupture of vessels would determine an amputation; comminuted fracture of bone generally either excision or amputation. Rupture of nerve would not of itself suggest amputation, for the nerve might be cleaned, refreshed, and reunited by means of catgut sutures. At the elbow, for instance, the ulnar nerve may be torn across, and yet the forearm may be saved and the function of the nerve be restored after suture. An instance of this kind has lately come under the notice of the writer.

In an uncomplicated case of compound fracture the surgeon should cleanse thoroughly the exposed articular surface with a solution of one part of carbolic acid in twenty parts of warm water, and should syringe out the joint-cavity and interstices of tissue with the same solution. The dislocation being then reduced, wire sutures may be used to bring together the skin; but it is most important that a free and dependent opening should be left for drainage. Carbolised gauze dressings should then be applied, and the limb be fixed upon a splint.

If these dressings are not at hand, irrigation of the joint, either with water or some weak antiseptic lotion, is probably the best way of purifying the wound and allaying extensive suppuration. When there is difficulty in reducing the dislocated bone through the skin and soft parts, it is often advisable to saw off its extremity. This has been done at the hip, shoulder, ankle, and wrist, as well as in dislocation of the head of the astragalus. Compound dislocation at the elbow may frequently suggest excision in order to save a movable joint; but such excisions run a far less favourable course than those undertaken for disease. A few years since the writer was called to see a compound dislocation of the elbow with separation of the humerus just above the condyles. The loose piece of bone was removed, and the ends of the radius and ulnar were sawn off. The patient recovered without any serious symptoms, and the hand was thus preserved, but a flail-like movement followed at the elbow.

In compound dislocations of the lower extremity it is scarcely advisable to make any attempt to preserve a movable joint. The wound having been cleaned and all loose fragments of bone removed, the limb should be fixed on an iron splint and retained rigidly in position by means of waxed, paraffin, or plaster of Paris bandages, till all inflammation and suppuration have subsided. A similar rigid fixation of parts should be secured in any case that the surgeon may have thought favourable for primary excision. Any abscesses which may result from the injury should be freely opened, and whilst the patient's strength is being drained by suppuration he should be supported by stimulants, quinine, iron, and such nourishing diet as he may be capable of taking. If it is evident that he is gradually losing flesh and strength, the surgeon must interfere at the proper time, and insist on the necessity of amputation to prevent further strain on the constitution and consequent death from exhaustion. After such amputations, provided there is no general septicæmia, patients often recover rapidly.

Extension and counter-extension in the treatment of dislocations.—Rotation, as a method of reducing dislocations, being only of service in the case of enarthrodial joints, extension of the limb will continue the method most generally applicable for the restoration of displaced bones to their proper positions, though, with the aid of chloroform, the power exerted need be comparatively little, save in the case of dislocations of long standing. *Extension* may be applied directly by the surgeon grasping the limb in his hands and pulling upon it, or indirectly through a round towel secured by means of a clove-hitch to the limb. The advantages of the towel are that it gives a firmer hold, and that it enables more than one to aid in making extension. It should be applied above the elbow for dislocation of the shoulder, and above the knee for dislocation of the hip, so that traction may not be exerted on any other joint than the one dislocated. To protect the skin from injurious pressure it is well to first apply a few turns of a damp flannel or linen bandage. Additional force may be obtained by the employment of pulleys, or such mechanical contrivances as Bloxam's dislocation tourniquet and Jarvis's adjuster; but since the introduction of chloroform these appliances have been altogether discarded for recent dislocations, and are but rarely employed for those of long standing.

Counter-extension is the force used in the direction of the patient's body, to prevent him from being dragged away by the power used in extension. It is seldom that the weight of the patient is alone sufficient for counter-extension when reducing a dislocation, though in the case of fracture the patient's inertia is thus frequently made use of. Counter-extension is sometimes made by the surgeon himself, as when he places his heel in the axilla or foot upon the perinæum for the reduction respectively of the shoulder and hip. At other times, when greater force is required, the counter-extension is entrusted to assistants; but when pulleys are used it is necessary to fix the pelvis or shoulder girdle by means of a padded leather strap, a round towel or sheet, attached above to some fixed point. However applied, it should be understood that counter-extension ought to be of a passive kind, continuously acting in one direction, whilst extension, which is more immediately under the control of the surgeon, may be modified both in force and direction according to the requirements of the case.

Unreduced Dislocations. — When a dislocation has been overlooked or left unreduced, the deformity occasioned by the displacement becomes gradually more evident than at the time of the accident, first from the absorption of extravasated blood, and afterwards by the wasting of the disused muscles around the joint. Loss of motion, however, seldom remains absolute, the movements gradually improving after a time, and sometimes becoming extensive. This is especially the case in dislocations of enarthrodial joints, such as the hip and shoulder. Here the displaced bone will hollow and form for itself a new cavity on the surface where it rests; new ligaments are formed from the connective tissue cells of the surrounding structures, and a fairly well-formed joint results. The process by which this new adaptation is effected is not a mere passive absorption occasioned by the pressure of the displaced head of bone, but an active sub-inflammatory change, whereby new bone is produced where required to resist pressure, and new ligaments of great density are developed to complete the joint. Meanwhile the cup, from which the dislocated bone has escaped, undergoes atrophy, decreasing in depth and diameter, and becoming filled partly with bony undergrowth and partly with fibrous tissue. A good specimen of unreduced dislocation of the head of the femur upon the pubes, illustrating these changes, is to be found in the museum of Guy's Hospital. The dislocated head resting against the anterior inferior spine of the ilium had there excited such activity in the periosteum and its fibrous connexions, as to form for itself a shallow cup, whilst the acetabulum is seen to be contracted and shallow.

The chronic inflammatory changes brought about by the displaced bone give frequently to the new joint an appearance similar to what is met with in osteoarthritis, plates of bone being formed in the fibrous structures around, whilst the cartilaginous surface becomes worn off, and replaced by a porcelain-like lamella. This loss of cartilage does not, however, always take place, as is proved by a case dissected by Cadge sixteen years after upward dislocation of the hip. The new joint was remarkably complete, and lined by a dense, pearly-white tissue resembling fibro-cartilage, whilst the head of the femur was still covered by its cartilage. Thus it will be seen that in some cases a new articular surface—framed on the model of the original joint—new ligaments, and new synovial membrane may be developed to take the place of a joint destroyed by dislocation. But the displaced bone does not always accommodate itself in this way to its altered relations, and ginglymoid joints, when dislocated, often become permanently fixed by fibrous or even bony ankylosis. Much will depend upon how soon after the injury movements are commenced, and with what perseverance they are continued.

Treatment.—The reparative and pathological changes which have been described as occurring in the neighbourhood of a joint long dislocated, should be borne in mind by a surgeon contemplating the reduction of any such dislocation, and he should ask himself whether the benefit likely to accrue sufficiently justifies the risks to which the patient may be subjected in attempts made to replace the bone. The opposition of fibrous bands of great density, of rigid and contracted muscles, of displaced tendons and intervening capsule, will have to be encountered, as well as the obstruction resulting, in cases of long standing, from altered bone-surfaces. No fixed rule can be laid down as to the time when it ceases to be justifiable to attempt reduction, as reparative activity will vary with the individual, and will not progress evenly with time. Astley Cooper's oft-quoted rule is given in his own words, to show that even he, writing before the days of anæsthetics, was not so rigid in his views as has been represented. 'I am of opinion,' he says, 'that three months after the accident for the shoulder, and eight weeks for the hip, may be fixed as the period at which it would be imprudent to make the attempt at reduction except in persons of relaxed fibre, or of advanced age. At the same time I am fully aware that dislocations have been reduced at a more distant period than that which I have mentioned; but in many instances the reduction has been attended with the evil results which I have just been deprecating.'

Among the evil results of prolonged and forcible extension, carried out with the object of reducing a dislocation, the following may be mentioned as having occurred in attempts to reduce old dislocations of the shoulder:—Severe subcutaneous lacerations resulting in extensive blood-extravasations; rupture of the axillary vein or artery, with subsequent traumatic aneurism; tearing through of the pectoralis major or cords of the brachial plexus; fracture of the humerus, glenoid cavity, or axillary ribs; rupture of the skin, and in one case recorded by Guérin, the limb itself was torn off at the elbow-joint. In attempts made to reduce old dislocations at the hip, the large vessels are less exposed to injury, though they have not always escaped; but fracture of the femur is an accident which has happened on several occasions, and diffuse suppuration has frequently followed forcible manipulation, and has sometimes ended in death. At the elbow-joint, rupture of the brachial artery and damage to the median nerve have resulted from force used to reduce an old dislocation. In spite of the warning of these accidents, cautious attempts at reduction may be made after lengthened periods, especially in persons of slight muscular development, and those in whom, the dislocation having been overlooked, splints may have been applied, and no previous attempts have been made to replace the bone. Should, however, sufficiently free movement have been obtained in the dislocated position to render the limb of service, it may be doubted whether any attempt at reduction is then advisable.

For the reduction of long-standing dislocation, an anæsthetic should invariably be administered till complete muscular relaxation is obtained. The surgeon should then take the limb, flex, extend, abduct, adduct, and rotate it till all the fibrous adhesions are broken down. In addition to this he may find it necessary to divide, with a tenotomy-knife, bands which cannot be broken, or displaced tendons which obstruct the return of the bone. Having overcome all resistance to the free movement of the bone, he next proceeds to manipulate it in a manner best calculated to restore it to its proper position. He must not expect to hear it return with a jerk and snap as in recent cases, but must be content to see the limb restored to its normal length and position as sufficient indication that the bone has returned to its cavity. Having obtained this result he should secure the limb in this position by means of splints, and apply over the joint an ice-bag or Leiter's coil to subdue any inflammation that may have been excited. The head of the bone, when lodged over the spot it should normally occupy, will gradually cause absorption of any capsule, fibrous or muscular tissue intervening between it and the socket. In the *Guy's Hospital Reports* for 1884, there are, related by Cock, several cases of dislocation of the shoulder which could not be reduced, owing, as it was supposed, to the intervention of capsule; but good results were eventually obtained by retaining the humerus in position by means of an air-pad in the axilla, till absorption had taken place and new ligaments had been formed.

For description and treatment of individual dislocations, *see* under Ankle; Elbow; Hip; Shoulder, &c.

R. Clement Lucas.

DISSECTING ANEURISM. *See* Aneurism.

DISSECTING WOUNDS. *See* Poisoned Wounds.

DISTAL LIGATURE. *See* Aneurism.

DORSALIS PEDIS ARTERY, The, is a continuation of the anterior tibial, from the middle of the ankle in front, to the interval between the bases of the first and second metatarsal bones. The guiding line is taken between the points mentioned.

The coverings are: skin; superficial fascia, with a plexus of veins and the musculo-cutaneous nerve; deep fascia; just before it ends it is crossed by the innermost tendon of the extensor brevis digitorum. Inferiorly it rests on the astragalus, the scaphoid, the internal and middle cuneiform bones. Externally are the innermost tendons of the long and short extensors. Internally, and serving as a guide, is the tendon of the extensor proprius pollicis. The nerve is on the outer side; venæ comites accompany the artery.

Branches.—(*a*) The tarsal, running outwards on the bones, to anastomose with the anterior peroneal, external plantar, and the metatarsal artery. (*b*) The metatarsal runs across the bases of the metatarsal bones; it has similar anastomoses to the tarsal. (*c*) Dorsalis hallucis. (*d*) Communicating with the external plantar, passing downwards between the first and second metatarsals. In the sole the communicating gives off (*e*) the anterior magna pollicis.

Ligation.—Make an incision in the guiding line two inches long; cut through skin and fasciæ, and feel for the pulsations of the artery; recognise the innermost slip of the extensor brevis digitorum on the outside and the pollicis on the inner side; and, pulling the former outwards and the latter inwards, open the sheath and pass the needle from without inwards, to avoid the nerve. Sometimes the artery is absent.

James Cantlie.

DRACUNCULUS. *See* Filaria or Dracunculus Medinensis.

DRAINAGE is the system by which the surgeon carries off liquid accumulations from the body, as the agriculturist does from the land. Both know that, while some moisture is essential to nutrition and growth, its excess leads to decomposition and waste. Drainage was the intention of the old surgical practice of counter-openings, tents, and setons; and John Hennen went so far as to draw a woollen thread through an accumulation of pus '*to perform the part of a syphon.*' But it was not until 1855 that Chassaignac established drainage, as a general principle and practice of surgical therapeutics. He was not only influenced by the idea, but followed the method, of agricultural drainage, substituting for tile drain-pipes perforated indiarubber tubes, which, after trial of metal and bone tubes, are still admitted to be the drain-pipes most generally applicable to surgical practice. The essential facts in Chassaignac's system of drainage are—that indiarubber tubes may be made to traverse and dwell in the muscular and bony structures of the limbs, the large joints, or the great visceral cavities, without producing irritation; and that, as they fill with discharge by capillary attraction, they do not give admission to air from without. Acting on these lines, the distinguished French surgeon and his earlier followers, employed drainage in evacuating purulent collections; but the method has been gradually, and most beneficially, extended to the prevention of suppuration, by carrying off serous effusions. These, if retained, are liable to decomposition, and, by mechanical tension and nerve-irritation, are potent causes of inflammation, which is opposed to healthy nutrition and repair, and is the prime factor in the chain of pathological events leading to blood-poisoning and death.

But though tubes be the most generally applicable instruments for drainage, it is important to bear in mind that they are not essential to it. The parallel between agricultural and surgical drainage holds good in the utilisation of natural, physical, and physiological resources for preventing the stagnation of liquids, and carrying them off when they do accumulate. In the flesh, as in the field, position both dams and drains.

To facilitate drainage by gravitation should always be the aim of the operating surgeon in planning the direction and extent of wounds, in the manner and time of closing them, and in placing the patient after operation. Thus, in amputation of the breast, a free incision, parallel with the transverse axis of the body, is most conducive to healing by the first intention, or favouring natural drainage outwards and downwards; all the more so if the patient's bed be so made as to incline the body slightly towards the side operated on. One great advantage in Teale's method of amputating results from the facilities for natural drainage, offered by the position and shape of the rectangular flaps. When extravasation of urine attends stricture, a free dependent incision in the middle line of the perineum arrests mischief, locally and constitutionally, in direct proportion as it favours easy drainage. On the same principle is based the golden rule, that when it is determined to open an abscess the most dependent position should be chosen.

As position assists natural drainage, so does pressure; and, by a little ingenuity, pads may be adjusted to act as banks in directing outwards extravasated fluids, and preventing their permeation into healthy tissues. But however dexterously and economically natural resources be utilised, drainage is often impracticable without the employment of tubes. In introducing these, probes and trocars are useful adjuncts, but they may generally be dispensed with by just inserting the end of the drainage-tube into the wound, and passing it with a gentle corkscrew impulse. In the case of fresh wounds, the drainage-tube is laid where most convenient before the edges are brought together.

Drainage-tubes, like most other good things, are liable to abuse. They may often be dispensed with by lightly compressing wounds and their surroundings to check effusion. Dryness favours healing. A slight dependent opening is a useful safety valve, not always indispensable, but, in case of doubt, never to be neglected. When drainage-tubes *must* be used, they should be neither too fine nor too short for efficiency, nor so numerous, thick, and long as to act like foreign bodies, and prevent the contact of surfaces of which the coalescence is desired. For the same reason, drainage-tubes should be shortened as soon as practicable, and removed when they cease to be absolutely necessary. In case of doubt, a wire or thread may be left in the track of a removed drainage-tube, and used in drawing through another, if required. Meanwhile, the wound can be allowed to consolidate under pressure and absorbent dressings, which are always the complement, often the substitute, of drainage-tubes. To prevent the tube completely slipping into the wound—a not infrequent and rather troublesome occurrence—its outer end should be left of good length, or be secured by one or two loops threaded through its side, and fixed by adhesive plaster or bandage. Catgut and horsehair are often used as minor drains, but absorbent dressings and gentle pressure will dispense with their necessity in the great majority of cases.

To secure the combined effect of position, pressure, and drainage-tubes, in carrying off discharges, it is important to secure the freedom of the outer end of the tube. This may be done by passing it through a hole in the dressings next the body, or between the edges of two pads or folds of absorbent tissue, the bandage exercising pressure around the tube so as to direct fluid through it, and not over its orifice so as to close it. An absorbent pad, lightly secured over the outer end of the drain-pipe, acts as the receptacle of the drained products, and may be changed as often as deemed necessary, without prejudice to the great principles of rest and cleanliness. Thus utilised, drainage is, in itself, a great therapeutical resource, and in combination with other principles of treatment, more especially rest, position, and pressure, is a powerful factor in the physiological treatment of surgical states.

SAMPSON GAMGEE.

DRAINAGE-TUBES.—Of the materials used for draining wounds, the most widely employed is india-rubber tubing, but decalcified bone, glass, metal, and spiral wire tubes either are or have been used, and, under special circumstances, strands of horsehair, silkworm gut and catgut act efficiently. The size of the tubes will depend on that of the cavity to be drained; but for large surfaces, such as those of amputation flaps, two or three smaller tubes are preferable to a single large one placed across the wound, as they interfere less with the coaptation of the flaps, and favour the more uniform exit of the discharges. The depth of the wound should be ascertained with a probe or the sinus-forceps, and the tube cut to the required length, and also in such a way that the external aperture lies flush with the surface; for if left too long the pressure of the dressings may double the tube on itself, and obliterate its channel, or press the inner extremity of it against the tissues and irritate them. Care must be taken that the external end of the tube does not slip within the wound, and with this object a loop of silk or horsehair should be tied to each side of that end, so that the pressure of the dressing against these little anchors of silk or horsehair may maintain the tube in its place.

When tubes are placed in cavities such as the thorax, special care must be taken that they do not slip inside; the safest plan is to fix the outer end of the tube to an india-rubber shield, thus:—Take a piece of sheet india-rubber and cut a hole in the middle of it of the size of the tube, then place the outer end of the latter through the hole, and cut the projecting piece longitudinally into four strips, and stitch each one down to the india-rubber shield. Drainage tubes do not, as a rule, need removing till the third or fourth day, by which time a track will be formed, which will facilitate their replacement. They will need shortening from time to time, according to the progress of the case. *See* EMPYEMA.

India-rubber tubes.—The red rubber tubes are the best, and the strength of the walls should be sufficient to maintain their patency against the pressure of the tissues; the size of them should vary from that of a quill up to that of the little finger. They should be perforated here and there with holes, extending over about one-third of their circumference; but when the tube has to pass some distance through the tissues before reaching the cavity to be drained, the outer part of it should not be perforated, as the granulations are liable to grow in and obstruct its calibre. The prepared tubes should be kept ready for use in a five per cent. solution of carbolic acid.

Decalcified bone tubes were introduced by Neuber, of Kiel; he used tubes drilled from ox-bones; Macewen, of Glasgow, advocated decalcified chicken-bones, on account of their cheapness. The tibiæ and femora, after being scraped clean, are placed in hydrochloric acid and water (20 per cent.) until softened; the marrow and endosteum are then removed, and the bones returned for a time to the acid; they are finally trimmed and perforated, and kept ready for use in carbolic acid and glycerine (1 in 10). The longest tubes are a little over three inches, and the widest over half an inch. In 100 observations, the time that these tubes resisted absorption was over eight days; if they be required to resist the tissues still longer, they should be kept in a chromicised instead of a carbolised solution. The advantages claimed for decalcified bone-tubes are that they are non-irritating, act as perfect drains, and are absorbed by the surrounding granulation-tissue when no longer required. On the other hand, it has happened that in some cases the wound has healed with the tubes enclosed and unabsorbed; whilst at other times they have been too quickly absorbed, and have collapsed before they have fulfilled their function.

Glass tubes have been introduced into ovariotomy practice by Keith; they are of various sizes, and have perforations at one end; through these apertures the fluid poured out into the peritoneal cavity, enters and rises in the tube, from which it is drawn off by a suction syringe.

Spiral wire tubes have been recommended by Robert Ellis as well adapted for draining circuitous tracts during long periods, on account of their bore not being diminished by bending, nor flattened by the contracting orifice of a sinus; they are made of fine brass or copper wire coiled into a spiral.

Strands of horsehair, catgut, or silk-worm gut make efficient drains, so long as the discharge is serous, but when it becomes purulent they cannot be relied upon; they all act in a similar manner, viz. by capillary attraction or syphon action, the fluids passing along the fine capillary channels between the hairs, &c. The horsehair should be purified in alkali, and then kept in a solution of carbolic acid (1 in 20). The size of the drain should be gradually diminished as required, by the removal of a few strands from time to time. It is claimed for catgut that it serves its purpose and is then absorbed, and so avoids both the necessity for dressing a wound in order to shorten the tube, and the difficulty of knowing at what rate to do this; and that with it, as with the decalcified bone drains, the theoretical perfection of one dressing only from first to last is possible. It should, however, be admitted that owing to the swelling of the catgut, and its incorporation with the tissues, its efficiency as a drain may be interfered with too soon, whilst in other cases it remains unabsorbed after it has ceased to be required.

BILTON POLLARD.

DRESSING OF WOUNDS. *See* WOUNDS.

DUCHENNE'S PARALYSIS. *See* PSEUDO-HYPERTROPHIC MUSCULAR PARALYSIS.

DUGAS'S TEST is for dislocations of the shoulder, and depends upon the fact that, owing to the roundness of the chest-wall, it is impossible for both ends of the humerus to be in contact with it at the same moment. Hence a patient with a dislocation cannot place the hand on the opposite shoulder with the elbow touching the ribs. *See* SHOULDER, Dislocations of the.

DUPUYTREN'S CONTRACTION is that deformity of the fingers which is due to a gradually increasing thickening and contraction of the palmar fascia and its prolongations into the digits. It is almost unknown in females, but is common in males after twenty-five years of age. Not a few instances can be traced primarily to injury, such as a punctured wound; some may be traced to the habitual use of instruments which cause pressure upon the palm, but in the majority no such cause can be ascribed, and the condition occurs in persons of gouty tendency or inheritance, although they may be exempt from other manifestations of the diathesis. It is very frequently hereditary. The contraction may be confined to the fascia of the palm, or it may be increased and even mainly arise from a contracted state of the palmaris longus. But the fact of most importance is that the tendons of the flexors of the fingers are unaffected and lie free in their sheaths and in their natural relations, and therefore removed from the bands, which are superficial and tangible. The joints also are unaffected. The ring and little fingers are most frequently implicated, but the middle, the index, and the thumb may be involved. Superficially the skin of the palm is puckered, and is bound to the subjacent ridge at the line of the transverse furrow, as well as at other spots, but is not closely attached throughout. The proximal phalanx is drawn down and cannot be straightened, and the two distal phalanges are similarly acted upon in proportion to the extent of the condition, which in extreme cases may be such that the tip of the finger is drawn down into the palm. Dissection proves that this is effected by the thickening and contraction of sections of the palmar fascia, which pass into the affected fingers, and of its prolongations, particularly those which are inserted into the periosteum of the first phalanx, externally to and along the borders of the sheath of the flexor tendons.

Treatment.—By far the most successful method of dealing with this condition is that of multiple subcutaneous incision, recommended by Mr. W. Adams. A fine short fascia-knife is introduced between the skin and the band, and the latter is divided from above downwards in several spots. The first incision should be above the transverse fold, the next between it and the web of the fingers, and others should divide the lateral band in the fingers. In the latter great care is needed that the point of the knife is not depressed, so as to injure the vessels and nerves. Each puncture should be covered by a pledget of lint, and the extended fingers bandaged to a padded metal splint on the palmar aspect of the hand. Subsequently, it is necessary that a metal apparatus embracing the wrist and extending along the dorsal surface of the finger, to the tip of which it is attached by a cap, should be worn for some time at night, and passive motion be used daily. Or, if immediate extension cannot be effected, it must be gradually brought about by means of a rack-and-pinion apparatus. Where this treatment has failed, or in cases where it is not applicable, a triangular flap of skin may be dissected up from the palm, and the contracted bands freely divided or even dissected out, the skin being readjusted and a splint applied. John H. Morgan.

DUPUYTREN'S SPLINT is a straight splint about four inches wide, reaching from the internal tuberosity of the tibia to four inches beyond the sole of the foot; it is notched at the lower end, so as to give the ankle-bandage a firmer grip of the splint. The pad, which should be thicker at the lower part, ought to reach only to the internal malleolus. It is used in the treatment of Pott's fracture, with much eversion of the foot. Bilton Pollard.

DURA MATER, Wounds of the. *See* Encephalitis, Meningitis.

DYSPHAGIA — or swallowing with difficulty—is a sign either of paralysis or of spasm of the parts concerned, or of disease of the pharynx and œsophagus, or of disease in their neighbourhood.

1. *Paralytic dysphagia* may have a central origin in disease of the brain or cord, and occurs after diphtheria or some other fevers; or it may have its origin in nerve injury or disease, either inside or outside the skull. Or it may have a reflex origin, from thoracic or abdominal disease. In paralysis of the pharynx, the finger passed into it causes no contraction; there may be dilatation of the parts, with accumulation of food; if regurgitation takes place, it is not so immediate and violent as in spasmodic dysphagia.

2. *Spasmodic dysphagia*, usually of central origin, may be due to some special cause, as strychnia poisoning or tetanus or hydrophobia, or inflammation of the cervical cord. It may occur early in insanity, and in epilepsy. It may have a reflex origin, from intestinal or uterine irritation, and perhaps many spasmodic strictures are started by some local irritation. The ordinary spasmodic stricture is usually a disease of nervous girls and middle-aged women; it often exists with other signs of nervousness in the patient or her family; it is very rare in men. It is, in many cases, not continuous or progressive or consistent

in its symptoms; it is not marked by much pain, or craving for food, or emaciation, or cough. There is no swelling in the neck, no secondary growths, no hæmorrhage. Solids may go down better than fluids; the degree and position of the stricture may alter; it vanishes under an anæsthetic.

Among the slighter cases are those of ‘stammering’ in deglutition, those of globus hystericus, and those where swallowing is painful and difficult long after an obstacle has been removed. In more severe cases there is complete inability to swallow: ‘the food is flung back by a spasmodic tube, not falteringly passed along a variable segment of a diseased one, or arrested as it nears the stricture to accumulate above its ring.’ This immediate violent return of a mouthful of milk or food, and its forced ejection through mouth and nose, is a very important sign of spasmodic stricture.

Spasmodic stricture is often cured by electricity. In cases plainly due to nervousness, frictional electricity, drawing sparks from the neck, is likely to do good. In cases where the continuous current is used, the positive pole should be at the back of the neck, and the negative should be over the pharynx, or inside if the patient can bear it. Tonics or antispasmodics may be given; the mental and moral tone of the patient must be improved. The introduction of a bougie may be followed by a hysterical fit, and rapid recovery. But in grave cases, of many years' duration, the cure is tedious, and relapses are common.

3. Of diseases of the *pharynx and œsophagus* which cause dysphagia, the chief are as follows: of the pharynx, acute tonsillitis, and perhaps—at least in children—mere chronic enlargement of the tonsils without fresh inflammation; acute pharyngitis, pharyngeal erysipelas, retropharyngeal abscess and tumour, and spinal disease, naso-pharyngeal tumour, and ulceration just at the back of the pharynx, which may be hidden by the uvula. Of the œsophagus, there are inflammation, both erysipelatous and membranous, pouches, diverticula, valvular obstruction, and certain innocent tumours. But, above all these, there are ulceration, simple or syphilitic, and malignant disease. Hence come simple stricture and malignant stricture; but in many cases it is not possible to decide which of these two is present.

4. *Simple fibrous stricture* is due either to simple fibrous thickening of the parts, or to the scarring and contraction of ulceration, simple or syphilitic. Simple ulceration follows the swallowing of boiling water, or soap-lees, or strong acid—either at once, or not for some months after the accident. There is no tumour in the neck, no diseased lymph-glands; the emaciation is proportioned to the want of food; the stricture may bleed, but has no foul discharge; it may feel smooth to the bougie.

Its treatment is never free from risk of perforation, or of mediastinal inflammation even without perforation. The advice to pass bougies directly after the accident, without waiting to see whether stricture will occur or not, is wrong; they might just cause it. Only a little fluid food should be given, and nutrient enemata should be used for some days.

When the stricture has come, and instruments must be used, a black olivary catheter is useful. It may go more easily just after a mouthful of wine, and with the head a little thrown back. In a case under the writer's care, the patient, a girl of twelve, could pass the catheter herself, through a double stricture. A year may be spent before the stricture is dilated; and constant watching in after-life is absolutely necessary.

5. *Malignant stricture*, usually epithelial cancer of the upper or lower end of the œsophagus, is most common in men; it is very rare under forty. In most cases the dysphagia is gradual; but in some it comes without warning and with curious suddenness. The emaciation is usually more than is due to any mere want of food; the regurgitant food may be stained with blood; and, late in the disease, there may be a foul smell from the throat, frothy expectoration tinged with blood, and a perceptible fulness in the neck, with enlarged lymph-glands. Regurgitation, whether in fibrous or malignant stricture, takes about a minute; it may not occur at all. Pain even may be absent. With the bougie, and in some cases with the finger, a hard stricture is found, which may have a ragged feel.

In some cases, food may be given through a rubber catheter, or a fine tube may be worked down over a long catgut, and tied in; or Mr. Symonds' short tubes may be used, allowing the patient the pleasures of taste.

6. *Dysphagia* may be due to disease in the neighbourhood of the pharynx and œsophagus. Except some rare cases of dysphagia from advanced spinal curvature, or disease of the thyroid gland or hyoid bone, or mediastinal tumours, the diseases are usually laryngeal or arterial.

In laryngeal paralysis there may be dysphagia; for the larynx is raised, closed, and covered, in deglutition; and thus paralysis either of the external or of the internal laryngeal muscles may, by want of coordination, cause dysphagia. In inflammation of the trachea swallowing is painful, and therefore difficult. In œdema of the glottis, acute or chronic, there is dysphagia, and food passes into the larynx; and in perforation of the trachea from ulceration of the œsophagus, there is very distressing dysphagia, with violent coughing-up of food. Whenever dysphagia is connected with cough or dyspnœa, the larynx must be examined.

Aneurism of the carotid or innominate or aortic arch, may cause dysphagia, with pain at the sternal notch. It is unwise in these cases to pass any instrument down the œsophagus.

7. Lastly, a foreign body may remain lodged in front of the epiglottis, or in the pharynx, or buried in the loose tissue behind the pharynx, in such a way as to elude observation and yet cause severe dysphagia.

Stephen Paget.

DYSPNŒA, i.e. difficulty of breathing, is produced under all conditions which cause defective oxygenation and increased carbonisation of the blood, the anomalous composition of the latter acting in turn as a stimulus upon the respiratory centre, situated in the medulla oblongata.

Symptoms common to most forms of dyspnœa are: action of the accessory muscles of respiration; increased frequency, or possibly deepening and prolongation, of the respiratory movements; and—in higher degrees of difficulty of breathing—cyanosis, orthopnœa, dilatation of the pupils, and even general convulsions. In the most severe cases the action of the heart becomes irregular or arrested.

The very varied conditions under which dyspnœa may occur may be subdivided into:

Conditions preventing or impeding the entry of air into the air-passages.

I. *In the nose and naso-pharyngeal cavity.* (1) Acute catarrhal or inflammatory tumefaction of the mucous membrane (especially acute coryza in infants). (2) Neoplasms (mucous polypi, adenoid vegetations, naso-pharyngeal polypi, malignant growths). (3) Deviations of the septum nasi. With rare exceptions the dyspnœa in all these cases is not severe but characteristic. The mouth is kept open; respiration is accompanied by a snuffling noise, if the obstruction be situated in the nasal cavities proper; by more snoring sounds, if it be in the naso-pharyngeal cavity; the voice has a peculiar nasal timbre; the dyspnœa in the sucking child comes on when it takes the breast and in sleep, in cases of adenoid vegetations in sleep.

II. *In the pharynx.* (1) Acute tonsillitis and hypertrophy of the tonsils; (2) benign and malignant new-formations; (3) foreign bodies; (4) traumatic and œdematous pharyngitis; (5) syphilitic contraction; (6) retropharyngeal abscess. In these forms dyspnœa is accompanied by a rough, snoring noise, which is distinctly different from laryngeal and tracheal stridor, less distinguishable from the noise of nasal and naso-pharyngeal obstruction. The dyspnœa may be severe. The voice is thick, deglutition greatly impaired.

III. *In the larynx.* (1) Acute laryngitis in infants; (2) œdematous laryngitis; (3) abscess; (4) erysipelas; (5) laryngeal diphtheria (croup); (6) benign growths when large; (7) malignant neoplasms; (8) syphilis; (9) tuberculosis; (10) perichondritis; (11) ankylosis of the crico-arytænoid articulations, if the cords be fixed near one another; (12) lupus; (13) lepra; (14) fractures and dislocations; (15) wounds; (16) foreign bodies; (17) membranous occlusion (webs); (18) bilateral paralysis of the recurrent nerves (dyspnœa occurs on exertion only); (19) bilateral paralysis of the glottis-openers; (20) unilateral paralysis of a glottis-opener in infants; (21) spasm of the glottis; (22) perverse action of the vocal cords; (23) compression of the larynx by tumours, &c. Laryngeal dyspnœa is characterised by loud, stridulous, sometimes sonorous respiration, the inspiratory phase being, in most cases of laryngeal difficulty of breathing, solely or prominently concerned. It may, however, be purely expiratory (as in cases of pedunculated subglottic growths, driven during expiration against the lower surfaces of the vocal cords), or mixed (as in cases of compression of the larynx). It may be constant (as in paralytic affections), or intermittent (as in spasms); accompanied by disorders of the voice (as in most cases of laryngeal dyspnœa), or not (as in perverse action of the vocal cords, and in bilateral paralysis of the glottis-openers).

IV. *In the trachea.* (1) Benign and malignant neoplasms; (2) syphilis; (3) intratracheal stenosis, from syphilitic or traumatic contraction, foreign bodies, pseudomembranous deposit, post-tracheotomic granulations; (4) compression of the tube by goitre, aneurisms, enlargement of cervical or bronchial glands; tumours of the œsophagus, emphysema of the cellular tissue of the neck, diseases of the vertebral column or of the bones of the thorax, &c. In tracheal dyspnœa, respiration is accompanied by stridor similar to, but hardly ever as sonorous as, that of laryngeal dyspnœa, and the cough has a peculiar brassy character. A valuable differential symptom between laryngeal and tracheal dyspnœa is, that in the former the larynx makes considerable respiratory movements, whilst in the latter it stands quite still, however great the difficulty of breathing may be.

In all the cases under II.—IV., in which the narrowing is considerable, the respiratory movements are prolonged, and there is often inspiratory depression of the epigastrium and of the intercostal spaces. This drawing in is a valuable sign of the dyspnœa being serious. In such cases there is a tendency to œdema of the lung setting in. The degree of the dyspnœa does not only depend upon the degree of the stenosis, but also upon the quickness of the development of the latter. In equal narrowing of the lumen of the air-passages, dyspnœa is the greater the quicker it has become developed. For the differential diagnosis of the individual affections so far mentioned, the reader is referred to the corresponding articles.

V. *In the bronchi.* (1) Capillary bronchitis; (2) diphtheritic deposits; (3) foreign bodies; (4) intrabronchial tumours; (5) intrabronchial narrowing by thickening or cicatrisation in cases of syphilis, &c.; (6) compression of bronchi by aneurisms, mediastinal and pulmonary tumours and abscesses, enlarged bronchial glands, pericardial exudation, &c. In the cases mentioned under 3–6, there is on the affected side thrill and diminution of the thoracic expansion, full and high percussion-note, and absence or diminution of the respiratory sounds, which may be replaced—if the obstruction be only partial—by sibilant or rattling, often far-audible noises. The action of the other lung is often increased. The voice in these cases is clear, but may be weak.

VI. *In the lungs.* (1) Pneumonia and other inflammatory processes; (2) œdema; (3) collapse and atelectasis of the lungs; (4) diseases destroying the respiratory tissue (phthisis, gangrene, &c.); (5) compression of the lungs by pleuritic effusions or tumours; (6) hydrothorax; (7) pneumothorax. FELIX SEMON.

DYSURIA.—Difficulty in Micturition. *See* STRICTURE OF THE URETHRA.

E

EAR, EXTERNAL, Diseases of the. For convenience of description the ear is divided into three parts: external, middle, and internal.

EXTERNAL EAR.—*Methods of Examining the Ear.*—The best method of illuminating the interior of the ear is by means of reflected light from a concave mirror. Diffused daylight is the best, but failing this, lamp or gas light will serve the purpose. The mirror should be provided both with a handle and with some contrivance for attaching it to a head band, and should have a focal distance of about six inches. The patient should be seated between the light and the surgeon, with the affected ear turned towards the latter. The light should be thrown on the ear, and any abnormal condition of the pinna and the external orifice of the meatus noticed. The auricle should next be grasped with the fore and middle fingers of the left hand, pulled backwards and upwards, a speculum of the requisite size inserted with a gentle rotatory movement, and kept in position by the forefinger and thumb. Any flakes of epithelium or small masses of cerumen obstructing the view should be removed with a pair of angular forceps or by the syringe. If no exceptional obstacles are encountered, the entire osseous canal can be seen with the tympanic membrane stretching across its deeper extremity. This, in health, is of a delicate bluish-grey colour, and highly polished. The most prominent object to be seen on the membrane, near its upper border, is the short process of the malleus; projecting downwards and backwards from this, to a point somewhat below the middle of the membrane, is a white or yellowish-white streak—the handle of the malleus. Extending from the lower extremity of this, downwards and forwards, is a bright triangular reflection of light, called the cone of light, its apex directed to the manubrium. From the short process of the malleus can be noticed a ridge passing backwards to the periphery, called the posterior fold, and a smaller and less sharply defined one—the anterior—is seen in front of the process. The part of the membrane above these two folds is known as the *membrana flaccida.* If the membrane be very thin, the long process of the incus can be observed as a whitish streak, parallel with and behind the upper part of the manubrium. Having inspected the membrane, the next step is to ascertain its mobility, and the perviousness of the Eustachian tube. This may be effected by Valsalva's or Politzer's methods, or by catheterisation.

(*a*) *Valsalva's method* of inflating the tympanum consists in forcible expiration, with the nose and mouth closed.

(*b*) *Politzer's method* is as follows:—The patient is directed to take a mouthful of water and retain it till told to swallow; the nosepiece of the air-bag is then inserted into one nostril, and the escape of air through the nose prevented by closure of both nostrils with the index finger and thumb. As the patient swallows the bag is forcibly compressed. The effect of this, unless there be great obstruction in the Eustachian tube, is to force air into the tympanic cavity. If the auscultation tube be used during this operation, the current of air is distinctly heard to strike against the membrane, and inspection of the latter shows an alteration in its curve, and very often injection of its blood-vessels.

(*c*) *Catheterisation.*—To introduce the Eustachian catheter, it is held between the thumb and forefinger and passed quickly but lightly along the floor of the nose with the point downwards, till this touches the posterior wall of the pharynx; the instrument being rotated outwards, is withdrawn till the point is felt to pass over the rounded projection of the posterior lip of the Eustachian tube, when a further slight rotation upwards, and a gentle onward pressure, will cause it to enter the orifice of the tube (Politzer). Another plan consists in withdrawing the catheter till the curve is felt to ride over the soft palate; the point is then turned upwards and outwards as before (Grüber). A third is to turn the point of the catheter inwards, and withdraw it till the beak hooks round the posterior edge of the nasal septum. The catheter is then rotated downwards and outwards, describing rather more than half a circle, when the point is usually at the mouth of the tube (Löwenberg).

When the catheter has been introduced, it can be retained *in situ* by being held between the thumb and index finger of the left hand. If the use of both hands is required, the catheter may be held in position by Bonnafont's nasal clamp. Air can be injected into the tympanic cavity either by the mouth, or by means of an india-rubber bag fitted accurately to the catheter. Force must be carefully avoided in introducing the instrument, lest the point should lacerate the mucous membrane, and a dangerous emphysema of the neighbouring parts result on inflation. Sometimes, owing to an obstruction in the inferior meatus, the catheter cannot be introduced; in such a case it must be bent to a greater curve and passed through the other nostril. During inflation, valuable information may be obtained as to the condition of the Eustachian tube and of the tympanic cavity by means of the auscultation tube. In the normal state of the middle ear, the sound heard is of a distinctly blowing character. If the mucous membrane is abnormally dry, while the Eustachian tube is patent, the sound is harsh; if the tube is narrowed, the air passes through with difficulty and is but faintly audible; if fluid is present, either in the tube or tympanic cavity, a bubbling or gurgling sound may be heard; and lastly, if the membrana tympani is perforated, the air is heard to hiss and whistle through the perforation. The patient's hearing should be tested before and after inflating the tympanum, either with a watch or by Politzer's *acoumeter.* The condition of the auditory nerve and labyrinth should next be investigated by means of the tuning-fork (*see* DEAFNESS), and lastly the nasal and pharyngeal cavities should be explored (*see* NOSE; PHARYNX).

Among the affections of the EXTERNAL EAR the following are the most important:—

a. Eczema.—This occurs both in the acute and chronic forms. Sometimes it is primary, at others an extension of an eczematous condition of the face and scalp. Seldom affecting the entire auricle, it is often seen on the posterior surface or in the fossa of the helix. When eczema spreads into the external meatus, it may cause deafness by the swelling of the lining membrane, and by the accumulation of epidermic scales.

Treatment.—When the attack is confined to the auricle, the same treatment as for eczema elsewhere should be adopted; but when the disease involves the meatus, liq. plumbi subacetatis should be instilled into the ear during the early stages. Later, the epithelial accumulations should be wiped away by means of dry cotton-wool, and the surface brushed over several times with a concentrated solution of nitrate of silver (Argenti nit. ʒj. ad aq. f℥j.), and after this treatment, to avoid relapses, anointed for some length of time with Unguentum hydrarg. subchlor. (ʒj. ad ℥j.).

β. *Hæmatoma Auris* consists of an effusion of blood between the cuticle and perichondrium on the anterior surface of the auricle. It may occur spontaneously or as the result of injury. It is of a bluish-red colour, hard to the touch and rarely fluctuating. When traumatic there may be pain, and a feeling of heat and fulness in the ear; when spontaneous, it is painless. It is not unfrequently found among the insane. This affection is best treated by cooling lotions, such as Goulard water, or by cold compresses. When pain, if present, is unrelieved by these remedies, the hæmatoma may be incised and the contents turned out, and a dressing of a weak solution of boracic or carbolic acids and compresses applied.

γ. *Diffused Inflammation of the External Meatus.*—This lesion is rare except as the result of injecting irritating substances, or mechanical and traumatic causes. The symptoms are: great redness and painful swelling of the cutis, with sense of fulness in the ear, followed by a serous or viscid exudation, On examination, the epithelial lining looks whitish and sodden, and, on syringing, comes away in flakes and even as an entire cast of the passage. The hearing is, as a rule, normal or only slightly impaired; occasionally the patient complains of noises in the head, and even of giddiness. Sometimes the meatus is so contracted by the swelling that it is impossible to get a view of the deeper parts. The pain is often violent, and is increased by pressure on the ear or movement of the jaw. When very severe, the inflammation sometimes terminates in perforation of the membrana tympani, or in ulceration of the osseous wall and the production of granulations. The diagnosis of primary otitis externa is difficult, where an uninterrupted view of the whole meatus and membrana tympani cannot be obtained. The prognosis is usually favourable, but is less so when the membrane is perforated, or when granulations exist. When the osseous walls are carious, there is danger of the inflammation spreading to the cranial cavity.

Treatment in the early stages should consist in the application of cold compresses over the ear, and a leech or two to the tragus; and as soon as secretion is established, the instillation of a warm alcoholic solution of boracic acid (gr. x. ad f℥j.) or liq. plumbi subacetatis and glycerine, equal parts. When the attack is obstinate, the meatus may be painted with a solution of nitrate of silver (ʒss. ad aquæ f℥j.), or powdered boracic acid may be blown into the ear.

δ. *Circumscribed Inflammation of the External Meatus. — Furuncules.* — The symptoms of this affection are usually very marked; there is great pain, often radiating over the side of the head, increased by pressure on the auricle and movement of the jaw. At first the hearing power is normal, but later there is often deafness. On examination one or more circumscribed swellings are observed, sometimes nearly closing the meatus; these are not generally reddened, but are exquisitely tender when touched. Eventually the abscess bursts and the pain subsides, often, however, only for a time, as no sooner has one furuncule run its course than another appears. In severe cases there is considerable febrile disturbance, and where there is a succession of furuncules, the patient is greatly exhausted by pain and sleeplessness. Notwithstanding, the prognosis is good, any permanent impairment of hearing being rare.

Treatment.—At the commencement of the attack, hot fomentations should be applied, and a warm alcoholic solution of boracic acid instilled into the ear. When the meatus is much narrowed by the swelling, a plug of cotton-wool, soaked in equal parts of glycerine and laudanum, often gives great relief; and should the pain be very acute, a leech may be applied to the tragus. In the later stages, free incision should be made into the swelling, but if the incision be made too early it only relieves the pain for a time.

ε. *Otomycosis.*— This is a chronic inflammation of the external meatus caused by the presence of a vegetable fungus, generally belonging to the species of aspergillus. The symptoms are—pain, tinnitus, and slight impairment of hearing. On examination a serous discharge is observed, and the membrana tympani and adjacent walls of the meatus are covered with a yellowish-white or black spotted membrane, and, on removing this by syringing, the tympanic membrane and meatus are found reddened and swollen.

Treatment consists in frequent syringing with warm water or weak carbolic acid, and then filling the meatus with an alcoholic solution of boracic acid. Occasionally the aid of forceps is required to remove the fungus. Other remedies recommended are: chlorinated lime (gr. ij. ad aq. f℥j.), and hyposulphite of soda (gr. iij. ad aq. f℥j.).

ζ. *Foreign Bodies.*—Children are especially fond of putting a great variety of substances into the ear. Among the commonest are: peas, beads, cherry-stones, and bits of slate-pencil. In cases of neglected otorrhœa, flies and maggots are also sometimes found. The symptoms will depend very much upon the size, shape, and character of the substance introduced. Inanimate bodies give rise to no symptoms beyond possible deafness, unless pressing unduly on the membrane or walls of the meatus. Peculiar reflex phenomena are, however, occasionally observed, to be explained by irritation of the numerous nerve-filaments derived from the trigeminus and vagus. Thus, cases are recorded of persistent cough, vomiting, sneezing, giddiness, and even epileptiform seizures, which have ceased on the removal of the substance.

Treatment.—Having ascertained the presence of a foreign body, its removal should first be attempted by syringing in the usual way, or, this failing, with the head inclined downwards. Should syringing be unsuccessful, instrumental means must be tried. The form of instrument will depend much on the shape and size of the foreign body. Speaking generally, the most useful instrument for the purpose is one with a fine, blunt-pointed, hooked extremity. The surgeon should endeavour gently to insinuate this in the gap between the body and the wall of the canal, and special care must be taken not to drive the body deeper into the meatus. If the object is long and lying across the canal, it can most readily be removed by means of a fine pair of forceps. Failing other means, Löwenberg proposes applying to the object a small brush dipped in glue, and withdrawing it when the glue has dried. Syringing alone will not remove maggots; they must first be killed by dropping alcohol, chloroform, or olive oil into the ear. If the ear be inflamed from the presence of a foreign body, or by previous injudicious attempts at its extraction, the inflammation must be subdued prior to any operative measures being attempted.

Obstruction or Narrowing of the External Meatus.—Occasionally this canal is closed by membranous septa or cicatricial adhesions. These may be caused by the coalescence of granulations, or ulceration resulting from caustic substances, syphilis, &c., or by the continued contact of the abraded and thickened surfaces of the cutaneous lining.

Treatment consists in dividing the septa or cicatrices and introducing sponge-tents or cotton-wool plugs, to prevent union of the cut surfaces. More common than complete obstruction is narrowing of the canal. This may be congenital, or the result of inflammation or hyperostoses. Lastly, in old people, the external orifice may be reduced to a mere vertical slit, due to an over-flaccid condition of the fibrous tissue and skin of the cartilaginous canal. This condition rarely causes any appreciable deafness; should it do so, the introduction of a small silver or india-rubber tube will restore the hearing. *See* Aural Exostoses.

Injuries to the Ear.—Injuries of the external meatus affect the osseous more frequently than the cartilaginous portion; lesions of the latter are generally combined with those of the auricle. The osseous portion may be fractured by direct violence, as by some object being forcibly thrust against it; or by indirect violence, such as a blow or fall on the ear or head, or a blow on the lower jaw, driving the articular process against the walls of the meatus. Uncomplicated fractures either terminate in recovery or in caries and necrosis. More generally, however, they are complicated by injuries to the membrana tympani and tympanic cavity, the mastoid process, and even to the base of the skull. When the roof of the tympanum is implicated in the fracture, fatal meningitis may ensue. The membrana tympani may be injured by direct penetration of foreign bodies, by extension of a fracture of the base of the skull, or by sudden condensation of air in the meatus, such as occurs in a violent explosion. The prognosis in cases of injuries of the ear will depend on the complications which exist; thus a ruptured membrane will, in the majority of cases, quickly heal, with little or no impairment of hearing, provided the labyrinth be not involved in the injury. While, on the other hand, if the labyrinth is involved, the prospect of recovered hearing is extremely doubtful.

Treatment.—Injuries of the auricle and soft parts of the external meatus should be treated on general surgical principles. In rupture of the membrane, the introduction of fluids into the ear should be carefully avoided, unless suppuration is established. In most cases the membrane will speedily heal, but if inflammation ensues, cold compresses may be applied, and a leech or two to the tragus.

A. E. Cumberbatch.

EAR, INTERNAL, Diseases of the. The symptoms of disease of the internal ear are mostly subjective, and, where no lesion of the tympanic cavity affecting the labyrinth is present they are generally included under: (1) Deafness, (2) Tinnitus, (3) Giddiness or Auditory Vertigo, and (4) Nausea and Vomiting. Other symptoms, such as hearing a double sound, hyperæsthesia, &c., may be met with, but they are so rare that they do not require further notice here.

(1) *Loss of hearing*, when the acoustic nerve is involved to a marked extent, is shown by the acuteness being lessened both to aërial and osseous conduction, the latter being the test on which we mostly rely. If a nerve responds to a sounding fork by osseous conduction better than by aerial, and, compared with a normal ear, is equally or more sensitive by bone-conduction, the cochlear structures corresponding to the tone of the fork employed may be considered healthy. *See* DEAFNESS.

Cases arise in which the range of audition is limited either by congenital non-development or by disease, and this can only be determined by the use of numerous differently toned forks. Such cases are probably not rare in general nervous diseases, such as tabes dorsalis; but few investigations have been made on the point, and, as they are at present of more interest to the specialist than the general practitioner, they need not be further dwelt upon.

(2) *Tinnitus*, which may be continuous or intermittent, of all characters, localised in the ear, or extending over the cranium, is due to irritation of the acoustic nerve. It may be the only symptom present, but that is not usual.

(3) *Giddiness*, or *Auditory Vertigo*, is rarely followed by unconsciousness, comes on suddenly, causes the subject thereof to fall forwards or backwards, or to reel to one side. It is due either to labyrinthine pressure, or to reflex cerebellar irritation.

(4) *Nausea* is frequently associated with the above, but is not so common as any of the others.

It must be remembered that any of these manifestations may occur from changes outside, but acting upon, the labyrinth; and that the diagnosis can be effected only by the comparison of the perception of the bony with the aërially conducted vibrations, the history of the attack, the presence of any of the usual causes of labyrinthine affection, the symmetry of the loss, and the absence of any other change sufficient to cause a temporary impairment or abolition of function.

The *Causes* of the above symptoms are very numerous.

General Diseases of the System, and more especially the zymotic diseases, scarlet fever, variola, mumps, typhus, diphtheria, typhoid fever, either affecting or not affecting the middle ear, may cause such a condition of hyperæmia of the labyrinth that changes of a temporary or lasting character are induced. To anæmia, degenerative affections of the liver or kidney, disorders of the digestion, pregnancy, lactation, and menstruation, have been attributed prejudicial influences on the internal ear. But of all the general diseases causing abeyance or annihilation of the cochlear function, syphilis, either congenital or acquired, is the most frequent.

Acquired Syphilis is generally preceded by some mucous membrane affection of the ear, but it may attack the internal ear suddenly. It occurs in the secondary or tertiary stage, usually affects both ears, and commonly produces the three great internal ear symptoms—deafness, tinnitus, and giddiness. The worst cases of internal ear affection arising from this cause seen by the writer have been marked by the absence of severe secondary symptoms, and the accompaniment of retinal changes.

In *Congenital Syphilis* the external affections of the ear are ordinarily preceded by affections of the external tunics of the eye, and the malady of the cochlea is generally heralded by visible choroidal and retinal changes. *See* CONGENITAL SYPHILIS.

The origin of the malady may arise *in the cranium*, either from vascular changes therein, such as aneurism of the basilar or internal auditory arteries, atheroma, emboli, or hæmorrhages; or from obstruction in the venous circulation of the labyrinth, through changes in the superior petrosal sinus or other venous channels passing from the skull. Meningitis, cerebral or epidemic cerebro-spinal, cerebritis, apoplectic conditions, tumours, or abscesses may, and do, cause alterations at the auditory centres, in the course of the portio mollis, or in the labyrinth. Many *medicinal substances*, especially quinine, opium, alcohol, and salicine, produce abnormal conditions of the labyrinth, followed by tinnitus and deafness.

Diseases of the Middle Ear, by causing a rapid or continued pressure on the labyrinth, either directly on the fenestral membranes or by indirectly initiating reflex vasomotor labyrinthine changes; or, as in purulent middle-ear disease, by inducing caries or necrosis of the walls thereof, may effect a transient or permanent alteration of the delicate structures therein contained.

Sudden loud and unexpected noises, such as the firing of heavy artillery, or continuous and repeated concussions, as in boiler-making, often give rise to enervation of the acoustic, by causing a congested condition of the parts. Any condition, by which an excessive or decreased tension of the fluids of the labyrinth arises, will act prejudicially on the fragile membranes therein contained, and cause a diminution of the acuteness of hearing.

A primary affection of the internal ear, in which all the symptoms usually found are present, without marked cerebral, spinal, or middle ear complications, has been described by M. Menière, and received his name. The sufferer is attacked by sudden giddiness, causing an inclination to fall in one particular direction, accompanied by nausea, retching, pallor, and sweating. These may be attended with deafness and tinnitus at the time, or they may come on afterwards. Unconsciousness is rarely present, and the vertigo passes off while the tinnitus and deafness remain. These attacks generally return at varying intervals, each being succeeded by an increase in the deafness and the sounding, till even the latter is lost, and the acoustic insensibility is complete. When this occurs, the other symptoms may not return. The pathological conditions found have been accumulations of reddish lymph in the semicircular canals, without any recognisable cerebral lesion.

The *labyrinthine changes* found are numerous, and include the following, viz. tumours—fibro-vascular or cholesteatomatous—hæmorrhagic or serous extravasations, anæmic or hyperæmic conditions, suppurative inflammation, caries, necrosis, exostosis and non-development of the fenestræ, vestibule, semicircular canals, or cochlea.

Under the term *tinnitus aurium* are included all subjective noises causing an irritation of the nervus acousticus from whatever cause they arise. The kinds of tinnitus complained of are as varied as the causes assigned for them, and they may arise in any aural disease which produces a change of tension or of circulation, or an irritation of the acoustic directly. They may be occasioned reflexly by changes in distant organs, as in the stomach, liver, or teeth. The nerve may detect alterations in the muscular contractions of the muscles of the middle ear or Eustachian tube, or in the blood-flow through the vessels which surround it or supply it. These are, in reality, objective sounds, but are usually included among the subjective, and have been described as subjective entotic tinnitus.

The hallucinations of hearing of the insane are, in some cases, connected with peripheral aural disease, and disappear with the cure of that affection.

Deaf-mutism generally results from congenital non-development of the organ, or destruction of the hearing function, in children who have not yet learned to read. In the former cases heredity plays a weighty part, and, in these, the curtailment of the visual sense is frequently seen, especially *retinitis pigmentosa*, which should always be looked for in deaf-mutes, the offspring of consanguineous parents. The abnormal conditions found in the ear are complete absence of the labyrinth, non-development of the semicircular canals, absence of the fenestræ, or defective sound-conveying apparatus. It is found that 40 per cent. of such cases hear some sounds or even words, and it is the cultivation of this little remnant of hearing which has given rise to the boasted remedies for such sufferers.

Treatment.—It will be seen from the above that the causes of affections of the internal ear are not always discoverable, and that many which are recognised are beyond the skill of the surgeon. Of those which may be alleviated, the cases arising from middle ear affection stand first, and in these the local treatment of the affection is usually followed by amelioration or cessation of the labyrinthine symptoms.

In *hyperæmia* vesication over the mastoid process, by repeated applications of linimentum iodi or cantharides, local depletion of the stylo-mastoid supply by leeches or Heurteloup's artificial leech, combined with purgatives and abstinence from alcohol, tobacco, and excitement, are to be recommended.

In *anæmia*, fresh air, regular exercise, nourishing food, and the exhibition of ferruginous tonics embrace the treatment.

In *syphilitic affections* large doses of iodide of potass, and mercurial inunction, are frequently followed by diminution of the symptoms. Counter-irritation of the mastoid, and subcutaneous injection of from 5 to 10 minims of a two per cent. solution of the muriate of pilocarpine are advocated by some.

To relieve subjective tinnitus, bromide of potassium in 20-grain doses thrice daily, hydrobromic acid in 15 to 20-minim doses as frequently, and the chloride of ammonium in 10 to 20-grain doses have been found more useful than other internal remedies. Counter-irritation of the external meatus or mastoid, the injection of chloroform or sulphuric ether vapour through the Eustachian tube, the hypodermic injection of morphia, and the incising of the membrana tympani, have all been extolled, but, though sometimes beneficial, are generally found wanting.

In *acoustic paralysis*, the use of strychnia or phosphorus is occasionally serviceable. The continuous galvanic current has been often employed, and has met with varying success.

In *Menière's disease*, gentle purgatives, rest in bed, and slight counter-irritation to the neck, are all that are required for a short time. Should the symptoms continue, large doses of quinine—5 to 10 grains three times daily—are given by Charcot, while digitalis, the bromides, and the actual cautery to the mastoid, are employed by others.

In *deaf-mutism*, with the treatment of any lesion which can be detected, the education by lip-reading and the articulate speech system, which strengthens the organs of speech and breathing, and places the sufferer in a position in society far above what could have been hoped for before the system was introduced, is to be carefully carried out under experienced teachers.

W. Laidlaw Purves.

EAR, MIDDLE, Diseases of the.—*Acute Catarrh.*—Whatever causes acute congestion of the naso-pharyngeal mucous membrane, such as severe cold, the exanthemata, &c., may give rise to acute catarrh of the middle ear. The attack begins with a sense of fulness in the head followed by pain, which may be severe, though not usually so. There is dulness of hearing, which soon increases to more or less marked deafness. Sometimes tinnitus is present, and even giddiness, and in severe cases there is some febrile disturbance. On examination the meatus usually presents a normal appearance, or is but slightly congested superiorly, close to the membrane; it is rarely narrowed by subdermoid effusion. When the attack is slight, the membrane shows but little change beyond a dimness of its polished surface, but if more severe, there is redness of its upper posterior segment, or even of the entire surface. The cone of light is altered in position or may disappear. Sometimes the effusion of fluid into the tympanic cavity is so great as to cause bulging or even rupture of the membrane. When the latter occurs, the perforation speedily heals when the tension is relieved. The Eustachian tube is either narrowed or closed by the swelling of its lining membrane and by accumulation of mucus. The termination of the case will depend very much on the severity of the attack and the condition of the patient's general health. When mild the attack often subsides without treatment, but severe cases, if neglected, either end in the formation of an abscess or lapse into the chronic form of disease.

Treatment.—If the attack is not severe, confinement to the house for a day or two, astringent applications to the throat, and the use of Politzer's air-douche, will be sufficient to effect a cure. In severe cases, in addition to this treatment, a leech should be applied to the tragus and warm fomentations to the ear, or warm water with a little laudanum should be instilled into the meatus. If the membrane is distinctly bulging, great relief will be afforded by puncturing it with a double-edged cutting needle. When there is free secretion from the naso-pharyngeal cavity, a warm nasal douche (Boracis et Sodæ carb. āā gr. v. ad Aq. f℥j.) should be used for a few days.

Chronic Catarrh.—Various pathological conditions are included under the term chronic catarrh of the tympanum; but as in so limited a space it is impossible to describe all the symptoms met with, only a general description of the disease can be given. It probably never commences as a chronic affection, but is the result of repeated and slight subacute attacks, or of a single acute one. Even in the case of boiler-makers, engine-drivers, &c., a low form of inflammation is probably started by repeated concussions of the membrane. Constitutional syphilis, gout, rheumatism, gestation, and heredity are predisposing causes. The symptom generally first observed is hardness of hearing, particularly in general conversation; this is soon followed by tinnitus, although this symptom may be noticed by the patient before any difference in the hearing power is detected. The deafness often increases so gradually that it has probably been in existence some time before the patient notices it, especially when one ear only is affected. The hearing power varies in many cases with the state of the weather and the patient's health, being worse in cold damp weather or after fatigue; pain is rarely present, and is never severe. Sometimes the patient complains of giddiness, or actually falls when walking, and this even where there is no proof of organic lesion in the labyrinth. Sometimes there is a sense of tightness in the head, and a feeling as of the ears being closed by some foreign body. In certain cases patients can hear better in a noise, as when driving in a cab or railway carriage. On examination the meatus appears dry and shining; occasionally it contains impacted cerumen, the removal of which, however, does not improve the hearing. The appearance of the membrane varies greatly; sometimes unaltered, it more generally is whitish or brownish in hue. No congestion is visible, unless a slight subacute attack be present.

At times the anterior segment is depressed, in which case the handle of the malleus is sharply defined; at others the entire membrane is depressed and the handle of the malleus is tilted backwards and inwards. Opacities, calcareous deposits, and thin spots, the result of atrophy of the membrane, are occasionally seen. The cone of light becomes more horizontal, or is broken into one or more points. Rhinoscopic examination may show the Eustachian tubes obliterated by cicatricial bands, variously distorted and drawn out of place, or simply narrowed. The pharyngeal mucous membrane is swollen and congested, granular, or dry and pallid; in children adenoid vegetations in the roof of the pharynx are often found. The prognosis of chronic catarrh is not altogether favourable. Much depends on the age of the patient, the duration of the disease, and the liability to frequent subacute attacks. If the patient is gouty or rheumatic, if deafness is hereditary, or if the disease has extended to the labyrinth, the prognosis is unfavourable. Patients who hear better in a noise, in the writer's experience, never improve under treatment.

Treatment.—The nose and pharynx must first be thoroughly investigated, and, where necessary, restored as far as possible to a healthy condition (*see* NOSE; PHARYNX), and any disorder of the general health rectified. Astringents should be applied to the throat in the form of spray, lozenge, or gargle, and the tympanum inflated every third or fourth day, by means of Politzer's bag or the Eustachian catheter. In the writer's experience, the introduction of lotions and vapours into the tympanic cavity is very rarely of any benefit, and frequently does harm; while making an artificial opening in the membrane, incision of the posterior fold, division of the tensor tympani, &c., are operations to be undertaken only by experts, and are rarely attended with success. Under appropriate treatment some cases of chronic catarrh are greatly improved and others slightly so, whilst a large percentage unfortunately derive no benefit. Some cases improve for a time under treatment, but relapse as soon as this ceases.

Acute Purulent Catarrh is separated from the non-purulent variety, mainly for clinical convenience. It arises under the same conditions, and the symptoms of the two are undistinguishable at first; indeed, it is often impossible to say, at the outset of an attack, whether it will end in suppuration or not. In the suppurative variety the symptoms are generally more severe, and the pain greater. After a while the abscess bursts through the tympanic membrane, and the pain subsides or ceases. Examination of the ear, after cleansing, discovers a perforation in the membrane, which is usually single, but may be double. At first irregular in shape, it soon becomes more or less circular, and varies greatly in size and in situation. The epithelial lining of the meatus and tympanic membrane is whitish, sodden, and often shed in places; where this has occurred, the dermis is of a bright red colour. Occasionally, owing to some abnormality of the meatus or to the swelling of its walls, the perforation cannot be seen; when such is the case, the peculiar whistling sound heard on auscultation, during inflation of the tympanum, will prove the existence of a perforation.

Treatment.—The patient should be confined to the house at first, and a simple saline aperient administered. The pain should be combated by hot or cold compresses and warm instillations, or, these failing to afford relief, by leeches applied to the tragus. Politzer strongly recommends the application to the side of the head of a piece of cotton-wool, sprinkled with a mixture of equal parts of olive oil and chloroform. When the throat is affected, as is usually the case, an astringent gargle should be ordered, or the throat painted with nitrate of silver (Argenti nit. gr. xv. ad Aq. f℥j.) or chloride of zinc (Zinci chlor. gr. xx. ad Aq. f℥j.) If the membrane is distinctly bulging, immediate relief is afforded by incising it, and so assisting the escape of matter. When there is swelling and tenderness over the mastoid process, which are not relieved by leeching, a free incision may be made down to the bone. After the first severity of the attack has subsided, the ear should be syringed night and morning, and some astringent lotion used. (Some of the most efficient lotions for this purpose are Zinci sulph. and Acidi boracici āā gr. iv. ad Aq. f℥j.; Acidi boracici gr. x. ad Alcohol f℥j.; Liq. plumbi subacetatis and Alcohol, equal parts; Zinci sulph. gr. v.; Acid. carbol. gr. ij. ad Aq. f℥j.) Inflation by Valsalva's or Politzer's method, previously to syringing, will greatly facilitate the removal of the discharge from the tympanic cavity. This inflation serves also to preserve the patency of the Eustachian tube.

Chronic Purulent Catarrh.— This affection is the result of the previous acute form, and is very common in young people. The discharge is often profuse and offensive. The perforation in generally large, and at times almost the entire membrane is destroyed, in which case the malleus and incus have disappeared. The mucous membrane of the tympanic cavity can be seen, red and swollen. Often polypi are present, either springing from the cavity or from the meatus, or both. If the perforation be small, and the membrane is denuded of epithelium, red, and œdematous, this may be easily mistaken for a polypus.

Treatment.— The ear must be kept scrupulously clean, being syringed two or three times a day, according to the copiousness of the discharge; after each cleansing, the meatus is to be dried, and powdered boracic acid blown into it. (The barrel of a quill, with a piece of india-rubber tubing attached, makes a very convenient apparatus for this purpose.) If powdered boracic acid fails, some astringent lotion should be tried, and where the mucous membrane of the tympanic cavity is much swollen, absolute alcohol is the best application. This should be diluted, at first, with an equal quantity of water, and gradually increased in strength. Inspissated pus clogging the meatus and tympanum, and not readily removed by syringing, may first be softened with a warm solution of carbonate of soda (gr. x. ad Aq. f℥j.) Narrowing or obstruction of the Eustachian tube must be dealt with by means of Politzer's bag or the catheter.

The Artificial Drum.—After curing the purulent catarrh, should the perforation not close, and marked deafness remain, the hearing may often be greatly improved by means of the artificial drum. Without stopping to discuss the *modus operandi* of this drum, it may be stated that there are two varieties, Yearsley's and Toynbee's; all others are but modifications of these. The former is made by moistening a piece of absorbent wool and rolling it into a thin plug, about an inch long. This is passed, with a pair of forceps specially made for the purpose, till it is in contact with the membrane. When the right spot is discovered, against which the plug should press, the patient is at once conscious of an improvement in his hearing. Several trials are usually required before success is attained. Toynbee's drum consists of a thin circular disc of india-rubber, fastened to a piece of silver wire, long enough to allow the disc to reach the membrane, the disc being cut of the requisite size and shape before introduction. When a satisfactory result is obtained, the patient must be instructed how to adjust the drum for himself. The cotton-wool has the advantage over the india-rubber of being less irritating to the ear, and can be moistened with various astringents in cases where the discharge has not quite ceased; but, if used, it must be changed daily.

Complications.—Various complications may arise in the course of chronic suppuration of the middle ear. I. Polypi. II. Mastoid disease. III. Caries and Necrosis. IV. Meningitis and Cerebral Abscess. V. Phlebitis and Pyæmia.

I. *Polypi.*—These may arise during an attack of acute inflammation of the meatus, but more frequently during chronic purulent catarrh of the middle ear. They usually spring from the tympanic cavity, the membrana tympani, or the external meatus. Varying in colour from greyish-pink to bright red, smooth or raspberry-like on the surface, pedunculated or sessile, they vary greatly in size.

Treatment.—Small polypi, arising in the external meatus, can be readily extracted with a small pair of urethral forceps; when larger, with Wilde's snare. Those arising in the tympanic cavity may be removed with various instruments; but, on the whole, Wilde's snare is the best. Fixing the patient's head, insert the largest speculum possible, and throwing a strong light on the ear, pass the loop of wire over the tumour, till the resistance due to the wire reaching the pedicle is felt, and then cut through the growth. Should there be a difficulty in severing the pedicle, owing to its toughness, it is better to rotate the instrument several times, and, dividing the wire close to the ear, withdraw the snare, rather than run the risk of snapping the wire by putting too great a strain on it; in a few days the tumour will slough. The simplest method of removing a large firm polypus is to seize it with a pair of small dressing forceps, and twist it off at the pedicle by rotating the instrument.

II. *Mastoid Disease.*—This occurs in two forms: *α.* periostitis, *β.* muco-endostitis.

α. The symptoms are—great pain, often radiating over the side of the head, redness and swelling behind the affected ear, which often stands out more prominently than the other; there is also some febrile disturbance. After an interval, fluctuation can be detected. Occasionally the abscess bursts into the mastoid cells, in addition to opening on the surface. Sometimes the abscess will burrow beneath the muscles at the back of the neck, and may reach as far as the foramen magnum; at others it will track downwards beneath the sterno-mastoid muscle as far as the root of the neck.

β. This affection may be primary, although it is usually a complication of middle ear disease. The symptoms are deep-seated pain and tenderness only on making firm and prolonged pressure; swelling and redness are not marked symptoms, and may be absent. When severe, indications of cerebral irritation may exist, such as giddiness, tinnitus, squint, vomiting, &c. Sometimes the abscess makes its way through the mastoid process; at others it bursts into the cranial cavity. Rarely, instead of an abscess forming, the inflammatory products ossify, and the mastoid cells are converted into solid bone (osteo-sclerosis.)

Treatment.—If matter can be detected, the abscess should be freely opened; but if not, leeches should be applied to the mastoid process, and these failing to afford relief, an incision down to the bone must be made. Sometimes the meatus is much narrowed by œdema or by the pressure of matter which has burrowed posteriorly beneath the periosteum; in either case the right treatment is free incision. The discharge from the tympanum should be encouraged for a time by hot fomentations and syringing with warm water, and if a polypus be present it should be removed without delay. Should symptoms of brain-mischief supervene, the mastoid process must be trephined; in doing this, great care must be taken to avoid wounding the lateral sinus.

III. *Caries and Necrosis.*—This is also another not uncommon complication of chronic suppuration. Almost any part of the temporal bone may be attacked; the mastoid process, the tympanic cavity, the meatus, the boundary wall of the lateral sinus, or the petrous portion containing the labyrinth. Often the diagnosis is readily made, as when the mastoid process, or posterior wall of the meatus, is affected; but when the deeper parts are involved, it may be impossible to ascertain, with certainty, the presence of dead bone, although this may often be suspected. There are no special symptoms indicating dead bone, but paralysis of the portio dura in the course of a chronic purulent catarrh, a watery and offensive discharge, and polypoid granulations in the ear, resisting treatment, are all suspicious signs. Where it can be done with safety, dead bone should be removed.

IV. *Meningitis and Cerebral Abscess.*—Cerebral abscess has been found, *post mortem*, in cases of otorrhea, where no sign of caries or necrosis could be detected. More frequently, however, a diseased condition of the temporal bone is the exciting cause. When, in the course of purulent middle-ear catarrh, there is a rise of temperature, with headache, photophobia, optic neuritis, and vomiting, there is strong presumption that intracranial mischief has supervened, the symptoms of which need not here be further detailed. *See* ENCEPHALITIS.

A. E. CUMBERBATCH.

EBURNATION. *See* OSTEO-ARTHRITIS.

ÉCRASEUR.—This is an instrument for removing growths or diseased parts by the gradual tightening of a loop of wire or other material. The parts are crushed through, and vessels of considerable size may be divided without any hæmorrhage whatever. The essential part of the instrument is a loop of wire, wire rope, or chain, which can be reduced in size by a mechanism in a suitable handle. The ends of the loop are passed through a canula, or an eye at the end of the handle. Thence the wires are conducted to the handle, one end being attached to a fixed point, the other to a button connected with a screw, by turning which the wire is drawn down, the loop diminished, and the encircled parts constricted and divided. The length of the canula and handle and the play of the movable button will depend upon the size of the loop required, and the depth of the cavity in which the growth is situated.

Two modes of reducing the loop are in use—one, as mentioned above, where by the turning of a screw the movable end of the wire is drawn down, and the other a rack movement. The handle in the screw form is a revolving bar or wheel; in the rack form a bar working by a side-to-side tilting movement, which tightens the chain link by link. Where the part to be removed can be surrounded, as in a pedunculated tumour, the loop is either placed over the growth, or one end guided round the pedicle. Where this cannot be done, as in removing portions of the tongue, the wire is carried through at the desired point or points by a needle or canula, and the parts severed in one or more places. The loop may be prevented from slipping by transfixing the part with stout harelip pins, or a sort of pedicle formed by dividing the mucous membrane, for example, at the side of the tongue. The loop must be tightened slowly, and after every few turns the action must be for a few moments stopped altogether, to allow time for coagulation to take place, and for the slower division of the parts. In this way no hæmorrhage need occur at all, and the wire is less liable to break.

Somewhat modified, the écraseur is used in removing polypi from the ear and nose, the instrument being called a snare.

Charters J. Symonds.

ECTHYMA.—At a time when skin-diseases were regarded solely as forms of eruption, without taking fully into consideration their other important features, ecthyma was regarded as a definite pustular disease. This is, however, no longer the case, and the name 'ecthyma' might with advantage be dropped out of our nomenclature. It is, however, still used to indicate a large pustule, forming a conical scab, and somewhat resembling a superficial boil. It is met with among the poor and badly fed, in such diseases as scabies, phthiriasis, and eczema.

Robert Liveing.

ECTOPIA VESICÆ and EPISPADIAS. — The peculiar deformity of the bladder here treated of is always attended by a deficiency of the anterior or upper wall of the urethra, constituting the deformity of epispadias. Slighter degrees of the latter deformity are frequently found without the ectopia, but all the cases of *ectopia vesicæ* in the male which the writer has seen, amounting to between sixty and seventy, have been coexistent with epispadias. Many of these cases have been present in sickly-looking children and youths, not infrequently the subjects of tuberculosis. The proportion of females to males is very small —not more than one in ten cases.

Sometimes there are evidences of degeneration of the kidneys similar in its pathology to the ordinary surgical kidney, with cystic degeneration, and dilated pelvis and ureters. This condition is brought about by granular growths on the mucous membrane of that portion of the deformed bladder upon which the ureters open, causing obstruction to the flow of urine. The papillary orifices are irritated and inflamed by the friction of the clothes, and often present a warty appearance, with a rough surface discharging muco-pus, a condition resembling somewhat that of granular conjunctiva induced by entropion in the eyelids. These growths and thickening of the papillary orifice produce the ordinary effects of obstruction in the urinary passages, first shown by dilatation and hypertrophy of the ureters, and secondarily affecting the pelvis of the kidney. Sometimes a muco-purulent secretion issues from the orifice. In these cases a degree of albuminuria greater than is accounted for by the local cystitis is found.

But frequently no such signs of the condition of the secreting structure of the kidney are to be found, and great circumspection is required before the surgeon should attempt to relieve this deplorable condition of the patient by operation. In the experience of forty cases operated on by the writer, a fatal result chiefly from this cause, previously undetected, has occurred in four cases.

The condition of *ectopia vesicæ* is perfectly compatible with life prolonged to a considerable length, and even, it is said, with the power of procreation. The writer has seen cases in which the patient has reached the age of fifty to sixty years. Females thus affected have, in some cases, borne children.

Not uncommonly the sex of the patient has been mistaken, and partly from this error, and partly from the greater convenience of the dress, the miserable patient has been brought up as a female—the smallness of the testes, placed in a large labial fold of skin, leading to ignorance of their presence and meaning. This serious mistake is further promoted by the great width of the hips, and the waddling gait induced by the pelvic deformity, and by the feminine mode of micturition rendered necessary by the open bladder, in cases where the urine is retained for a short time in the dilated ureters.

The patient is usually first seen by the surgeon during infancy or childhood. In the hypogastric region the site of the *mons veneris* is occupied by a red vascular-looking projection, presenting a mistakable similarity to a nævus or malignant tumour, and reaching down to and involving the dwarfed and epispadiac penis. In the female it ends in a split clitoris, and merges into the *labia minora* on each side. But it will be observed that, when the child coughs or cries, the tumour will become tense and protrude in the way of a hernia, and probably a spurt of urine may jet out of two prominent conical elevations at the lower part, just above the stunted penis. When the jet is decided, this indicates always a certain amount of dilatation of the ureters. The jet of urine may also be produced by depressing the penis and thus clearing the uretal orifices. It will be noticed, also, that there seems to be a total absence of the navel cicatrix, rendering the upper and middle regions of the abdominal wall very peculiar in appearance.

Careful examination will show that just on the upper margin of the red protruding mass is a crescentic border of cicatricial tissue, which really represents the upper or omphalo-mesenteric part of the umbilicus. Above this will be seen and felt, in the median line—especially when the recti abdominis are put into action—a flat surface, hard and resisting, of from an inch to two or even three inches wide, bounded on each side by the recti muscles, and tapering upwards to the ensiform cartilage. This is the widened and expanded linea alba, and the structures covering the peritoneum here are sometimes very thin, although tough and resisting. The skin over this inter-rectal interval is smooth, and usually free from hairy growth. The recti are separated by the whole extent of the wide divergence of the superior rami of the pubes from the median line.

The penis is flattened out and stunted in length, and is applied closely to the lower surface of the exposed bladder between the uretal papillæ. On depressing it will be seen the urethral groove, showing the various urethral ducts and follicles, including those of the prostatic urethra. The prepuce is usually somewhat large, and depends like a dewlap, with the frænum preputii in the centre attached to the lower part of the corona of the glans penis. The scrotum is wide, shallow, and generally large, and often the testes are normally placed. But sometimes the dartos development is small and deficient, and the testes are in the groin. On each side of the penis and exposed bladder is seen an elevation or protuberance, which is caused by the forward projection of the pubic angles and their incomplete symphysial surfaces. Under the penis and below these projections can be felt a resisting ligament, which is found on dissection to be the strengthened and largely developed lower or suburethral fibres of the triangular ligament of the urethra. The subpubic ligament and upper or supraurethral part of the triangular ligament are, of course, wanting. Frequently there is found, on one or both sides, an oblique inguinal hernia, with the testis below, either in the scrotum or above it. This additional abnormality necessitates great care in dissecting up flaps while operating over the sac of the inguinal rupture.

The perinæum in these cases is short, and the anus placed somewhat more forward, and with a more anterior direction at the orifice, than is natural. The thighs are seen to be more separated from each other, and the pelvis and perineum wider than natural, giving an appearance and gait similar to that of a largely developed female pelvis. The pelvic skeleton in these cases is so peculiar that any of the bones forming it can be easily and separately recognised by the anatomist as affected by this deformity. The pubes are separated to the extent of from two to four inches, the superior rami shortened and directed forwards, and the obturator foramen diminished in size, narrowed, and turned outwards. The iliac bones are straightened out more than normal. The sacrum is very peculiar. The lateral curve, instead of being concave, is flattened out or even convex, with the ilio-sacral facets turned more outwards than normal, while the vertical curve is straightened.

The patient suffers much from the constant flow of urine, together with the friction of the clothing upon the exposed and inflamed surface of the bladder. When from errors of diet or hot weather the urine is rendered irritating, the suffering is greatly increased, and the unhappy patient is truly an object of commiseration and pity.

Treatment for the relief of ectopia vesicæ:—Some years ago Mr. John Simon proposed an operation for the relief of this deformity, which consisted in making a communication from the base of the imperfect bladder between the ureters into the rectum. The intention was to make this communication permanent, and then to cover the bladder entirely with skin. Mr. Lloyd also performed this operation upon a patient. The patients operated on in this way died without the permanent communication having been established, from extravasation of urine and peritonitis. Mr. Thomas Smith, in one case, detached the ureters from the bladder and passed them through an opening in the rectum, with the hope that they would become permanently adherent, and that the rectum would assume the functions of the bladder. This patient also succumbed to the irritation and diarrhœa produced by the constant presence of urine in the rectum.

It had been felt by surgeons since the modern revival of the art, that if a covering of skin could be provided for the bladder, the suffering would be much alleviated, especially if the flow of urine could also be directed over the grooved penis, and confined to that spot. Dr. Ayres, of New York, seems to have been the first to operate to relieve in this way a female patient in whom the clitoris was split and the vagina and bladder formed one large cloaca. He turned down a large flap of skin from the abdomen, with its raw surface uppermost, and endeavoured to get this to cicatrize and heal. The result was not very encouraging. Dr. Pancoast, of Philadelphia, tried in the case of a male patient to accomplish this end by turning over a lateral flap with its skin surface towards the bladder, and placed over it another lateral flap twisted so as to place its raw surface undermost upon the other. The surfaces adhered, but an opening remained upon the abdomen, above the flaps, through which the urine flowed, and this resisted all attempts to close it. Trouble was also experienced from the growth of hair into the bladder from the reversed flap. It was found in process of time, however, that the hairs finally ceased to grow, the bulbs being destroyed by the constant irritation of the urine. The operation does not seem to have been followed up in the United States by either of these surgeons or by others. Mr. Holmes, of St. George's Hospital, was the first to follow a modification of Pancoast's method in this country, in 1863, and in two of his cases was successful in making the patient more comfortable. About the same time the writer had his first successful case at King's College Hospital. His operation consisted in making lateral flaps of skin and uniting them, without reversal or superimposition, in the median line. Trouble was experienced in closing up the opening in the median line above the bladder, but after one or two unsuccessful attempts this was overcome, and the patient lived for nearly a year, wearing an india-rubber urinal comfortably, and then died of bronchitis. The parts were secured, and are now to be seen in the museum of King's College. The deep surface of the reversed skin, forming the new anterior wall of the completed bladder, is seen through an opening made in the hinder wall to be covered with smooth mucous membrane.

After several attempts, with variable success, the writer improved his operation in two directions—first, by having recourse to a reversed upper or umbilical flap, and by laying the two lateral transplanted flaps upon it. Since that plan was adopted, the upper opening, which formed at first such a difficulty, has been always closed by the first operation, or nearly so. But a fresh difficulty arose. From the constant hernia-like pressure of the abdominal contents upon the loose and flexible hinder vesical wall, the opening above the penis had a tendency to get larger and wider, and the bladder to protrude as the cicatrices contracted. To remedy this, a second operation, based upon M. Nélaton's operation for epispadias, was devised. The essential part of Nélaton's procedure was the raising of a bridge or double-rooted flap from the front of the scrotum below the penis, and passing the penis under this bridge so as to protrude below. A long narrow flap was reflected from the linea alba above, and laid over the grooved urethra with its skin surface downwards, and the bridge of scrotal tissue was then stitched upon it. The hair which afterwards grew upon the reversed flap from the site of the mons veneris, and blocked up the urethra, was a serious drawback to this method of procedure.

In the second or supplemental operation of the writer, the reflected flap for union with the superimposed scrotal bridge is obtained from the margin of the arch over the penis, formed by the union of the lateral or groin flaps, and the sides of the penile groove were also reflected so as to form a raw surface for the reflected flap to adhere to. The cases thus operated on, now amounting to forty in number, were rendered much more comfortable; and in one which was exhibited at King's College Hospital many times since, the patient has been successful in retaining the water for a short time when he lay down, by the use of an india-rubber nipple placed over the penis and the surgically-formed prepuce, so as to constrict them somewhat, and thus arrest the flow of urine. On coughing or sneezing powerfully, however, this is apt to slip, but answers its purpose on the whole pretty well. Other cases have worn an india-rubber urinal similar to that in use in railway travelling. Various modifications of this operation have been performed by different surgeons. A very successful one in a female child was lately published by Mr. Robson, of Leeds, in the *British Medical Journal*, January 24th, 1885.

The following is a description of the writer's operations for the relief of *ectopia vesicæ* and *epispadias*.

1. The first operation, i.e. for the *Ectopia*. The lower part of the abdomen and the genitals are first carefully cleaned and shaved. In cases where the hair is unusually abundant it is best, in the first instance, to remove it by some depilatory and by applying previously a drop of strong nitric acid to the several groups of hairs at

successive intervals, the bladder and other parts being carefully protected by a mixture of olive oil and chalk laid on freely. When the skin has healed, after the action of the acid, the parts should be well washed with a 2½ per cent. solution of carbolic acid, in which all the instruments used in the operation should be steeped. The patient being anæsthetised and laid flat on his back, the flaps should be marked out by a pen-and-ink mark.

The upper flap should be figured by a line extending along the side of the bladder-surface vertically upwards as far as the measured distance from the root of the penis to the upper margin of the bladder, and then carried in a rounded curve across the 'linea alba' at this point to join another vertical line of equal length on the opposite side of the bladder. The two groin flaps for superposition are to be made of a rounded lancet-shape, with their roots downwards and inwards at the base of the scrotum, and continued along the side of the urethral groove for about half its length. These flaps should be long enough and detached enough to meet in the median line for their whole length, and no sharp angles should be left in their outline. The incision for making them should join that of the lateral border of the first or umbilical flap at about its centre. In raising the umbilical flap, care must be taken not to make the skin too thin, which is apt to be done in the centre of its base near the upper margin of the bladder. At this point there is little or no subcutaneous tissue, and the aponeurotic and tense linea alba is thin and easily injured by the knife, consequently the greatest care is required to avoid opening into the peritoneum or subperitoneal fascia. This accident, in one case in Paris, under M. Follet (a pupil of Nélaton's), caused the death of the patient from peritonitis. The urine could not be prevented from passing afterwards into the wound.

It is better to lay hold of the flap with the fingers than to use the forceps, which are apt to damage the vitality of the edge of the flaps, upon the direct union of which a good deal of the success of the operation depends. In raising the lateral or groin flaps the superficial external pudic vessels are divided, and are often large enough to require ligature. After being raised the flaps should be folded back, so as to lay bare the raw surface, which should be suffered to become glazed, after all bleeding has ceased, and all clots are removed with a saturated solution of boracic acid in the form of spray. The upper or umbilical flap should first be dealt with, folded evenly down with its skin surface to the bladder, its corners being stitched with thickish wire sutures to the cut edge at the root of the penis on each side. The ends of the wire should be left so long as to project, with a view to their easy removal. A single half-knot tied on them in the usual manner, and held by a sharp bend back at both ends, is the best way of securing the wire (the thickness of which should be enough to hold the bend or kink without untwisting). The groin flaps should then be placed upon the raw surface of the umbilical flap, with their inner edges held in contact along their whole length by six closely-applied wire sutures. The bases of these flaps should pretty closely embrace the root of the penis. The raw surface left by the reflection of the umbilical flap can be easily covered by drawing its edges together with three or four strong and long harelip pins, which have the effect of relieving any strain which may affect the reflected flaps. At this stage of the operation the patient's shoulders should be well raised and his knees bent and adducted, to diminish the stretching of the abdominal parietes. The upper borders of the groin-flaps may be held upwards by one or two thick wire sutures, but the site of the groin flaps should be left to heal by granulation.

During the operation the knife should be kept carefully in hand, especially if a cough or uneasiness under chloroform affects the patient and causes sudden bulging of the bladder. The latter should be repressed by holding a soft sponge firmly upon the flaps. This pressure has the additional advantage of squeezing out the urine and causing the sticky, glazed surfaces of the flaps to adhere together. On being removed to bed, the patient must be kept doubled up, and never allowed to stretch himself out. He should be placed on a waterproof in a sitting posture, with his shoulders well propped up behind, a thick bolster under his knees, and a bandage passed round the knees and over and across the shoulders and back, to maintain the flexed position while being removed. The wounds should be painted over with collodion, and a few drops of oil put into the urethral opening, to spread over the bladder surface and promote the free passage of urine.

In the female the umbilical flap should be large, and the incision for the groin flaps on each side should be carried well down, so as to have their roots in great measure connected with the labia. When they are placed together and stitched upon the umbilical reversed flap, the vagina should be almost closed up by them, with but a small opening to allow the passage of the urine. Through this opening a very large india-rubber drainage-tube should be kept in the vagina, and be changed and cleaned daily.

As the cicatrix contracts in the male patient, the urethral opening may become considerably enlarged by the hernia-like protrusion of the hinder wall of the bladder, already alluded to, distending the aperture and depressing the penis. This change may be accelerated by repeated coughing or crying on the part of the patient. But the bladder and uretal openings are more or less effectively protected, by their deepened position, from the friction of the clothes.

As a supplemental procedure in the male, the following operation for the *epispadias* which remains, and for a preputial covering for the penis, will usually be found necessary:—

2. *Operation for Epispadias*, modified from that practised by Nélaton.

The patient must first have all the hair-bulbs, which are likely to give trouble afterwards by growing into the urethra, destroyed by strong nitric acid, as before described. When the skin is sufficiently healed, the parts must be carefully cleansed by washing wth a 40 per cent. solution of carbolic acid. The patient being anæsthetised, and placed flat on his back on the operating table, the surgeon makes an incision parallel to and half-an-inch above the arched cicatrized urethral border of the covering of the bladder, and then turns down by dissection a fold of the skin, with its skin surface placed upon the penis. The incision should be carried well along the sides of the urethral groove, so that the side of the penis is well denuded, and the urethral groove completely covered by the meeting of the inverted flaps in the median line. A cold soft sponge is pressed firmly by the assistant upon the bleeding surface with the penis firmly stretched out.

Then another curved incision is made below the root of the penis at the junction of the penis and scrotum, meeting the incision already described on each side. A third curved incision is then made along the lower border of the scrotum, longer than the former and with a downward projection in the middle to form the point of the prepuce. The intervening skin of the scrotum is then dissected up from the testes, leaving the bridge of skin, with pedicles three-fourths of an inch wide, thus formed, attached on each side to the top of the scrotum. The point of the penis is then depressed and pushed under the bridge of skin. The scrotum will then be found to cover the penis like a hood. The bleeding should be quite stanched by the pressure of an iced sponge, or by the application of thin catgut ligatures. The folds of skin which were first formed for the deeper covering of the urethra, are then turned with the skin-surface downwards upon the urethral groove, and stitched together in the median line with a continuous or glover's suture of tolerably stout wire, which is to be cut off long at both ends, so as to be withdrawn easily when no longer required. Over the freshly-denuded surface thus presented, the scrotal bridge of skin is placed, raw surface to raw surface. The upper margin is then stitched by closely applied interrupted sutures both along the upper and lower borders of the bridge-flap.

A large sized india-rubber tube, well oiled, is to be placed in the groove of the urethra, passing well into the bladder. It can be held in place by wires, fastened on each side to the silver sutures applied to the scrotum. Finally the lines of sutures should be covered freely with collodion, and the urethra well oiled. The patient should be placed in bed, sitting bolt upright, with his knees placed close together, and quite flat upon the bed. A mackintosh should be arranged under him so as to catch the flow of urine, and drain it off to the side of the bed, where a dish can be placed to receive it. A mild opiate may contribute to keep the patient quiet. He should be fed on milk, eggs, and beef-tea with bread sops.

In all these plastic operations on the bladder and urethra, it is essential that the sutures should be left absolutely untouched until they are clearly useless. It will be found to be more convenient to take all away that have not dropped off, at one *coup*, with the patient under an anæsthetic. This prevents a great deal of crying and straining, which try very much the newly-formed adhesions. About a fortnight after the operation will usually be found the best time for doing this. The silver sutures do no harm, set up no irritation, and keep quite clean.

If the flaps get hot and swollen about two or three days after the operation, much benefit will be obtained by irrigation with boracic acid lotion—a semi-saturated solution. The cradle used to keep off the bedclothes forms a convenient support for the irrigating vessel, and the fluid passes off by the mackintosh which conducts the urine away.

A modification of the operation just described has been found by the writer successful in a good number of cases of slighter conditions of *epispadias*. In many of these (as is usual), there was also incontinence of urine, from the groove in the urethra extending backwards into the prostatic portion, in the manner of a harelip, and preventing its grasp upon the neck of the bladder. This has been in many cases much improved by carrying the incisions well up to the prostate below the pubic symphysis (which is also frequently imperfect here). An india-rubber cap placed over and slightly constricting the penis and newly-formed prepuce, has, in some cases, been effective in retaining the urine for a considerable time, so as to keep the patient dry at night. In still slighter cases of *epispadias*, without incontinence of urine, the appearance of the penis has been improved by transplanting in the same way the redundant prepuce, which is nearly always found hanging below the penis like a dewlap.

By reversing this procedure, and placing under the penis the hoodlike termination of the prepuce, many cases of *hypospadias* —some of a severe kind—have, in the writer's practice, been much improved, and the urine conducted to the end of the penis, so as to render micturition more cleanly and comfortable. *See* Hypospadias.

John Wood.

ECTROPION, or Eversion of the Eyelids.—There are two forms, the acute and the chronic.

(1) Acute Ectropion is generally the result of the swelling and protrusion of the mucous lining of the lid in acute conjunctivitis. Occasionally, in children suffering from purulent ophthalmia, the upper lid may be completely everted. At first the lid may be easily replaced, but later, ulceration occurs in the crease of the skin, and this is followed by cicatrisation, so that the lid is permanently fixed in its everted state.

Treatment consists in relieving the conjunctivitis by appropriate remedies, such as nitrate of silver, and other astringent and antiseptic solutions.

(2) Chronic Ectropion may be due to disease or injury of the lids or adjacent textures, such as chronic conjunctivitis, chronic ciliary blepharitis, lupus, syphilitic and other forms of ulceration of the skin, and cicatrisation following wounds or burns of the lids, or caries of the orbit. Ectropion of the lower lid may result from paralysis of the orbicularis. One or both lids may be affected, and the eversion may be partial or complete. Besides the deformity, the patient suffers from overflow of the tears, consequent upon the displacement of the lacrymal puncta. If the eversion be of such a degree as to leave the cornea permanently uncovered, there is the superadded risk of inflammation of the conjunctiva and cornea, which may lead to intractable ulceration of the cornea. In chronic cases the exposed conjunctiva may become dry and semi-cuticular, or it may become thick, exuberant, and rough.

Treatment must be directed towards relieving the subjective symptoms and correcting the deformity. For the relief of the overflow of tears, one or other lacrymal canaliculus should be opened, and for the prevention or cure of conjunctivitis, or of ulceration of the cornea, mild astringent antiseptic lotions, as Lot. acidi boracici, gr. iij.–vj. ad f℥j., or Lot. quiniæ sulph. gr. ij.–iv. ad f℥j., should be gently used two or three times a day. In the intervals the lids should be protected by a light compress, smeared with boracic acid ointment (gr. x.–xx. ad ℥j.) In cases of eversion dependent upon, or associated with, hypertrophy of the conjunctiva, the exposed membrane should be gently touched once or twice a week with a stick of nitrate of silver, or a strip of the thickened conjunctiva may be excised. In eversion due to the formation of cicatricial bands in caries of the orbit, the adhesions may be freely divided subcutaneously with a tenotome. With a view to prevent recurrence of eversion after this, and the operative procedures to be enumerated below, it may be necessary to pare the edges of the lids and stitch them together, leaving them united till all risk of a recurrence of the eversion has passed. If the edge of the lid be elongated, and the skin fairly loose, the tarsal border may be shortened by the excision of a V-shaped piece, combined, if necessary, with a closure of the external canthus (tarsoraphia). In severe forms a plastic operation may be required (blepharoplasty), such as division and detachment of the cicatricial tissue which holds the lid back, or the introduction of a piece of new skin, either by a process of gliding, or interposition, or transposition of adjacent skin, or by transplantation of skin from more remote parts. For ectropion of the lower lid, due to paralysis of the orbicularis muscle, electricity should be used.

John Tweedy.

ECZEMA.—*Definition.*—Eczema is a simple, non-contagious inflammation of the skin, a characteristic feature of which is the formation of dry and red scaly patches, or, more commonly, of papules and vesicles or pustules, which break and leave excoriated surfaces, discharging a sticky, serous fluid, which dries into crusts and scabs. The disease is attended with more or less swelling and infiltration of the skin, and much itching.

Symptoms and Pathology.—The name 'eczema' is now used in a broader, though more exact, sense than formerly, and includes many conditions of the skin which were, until lately, regarded as distinct diseases, and classed respectively with erythema, lichen, pityriasis, or psoriasis, according to the degree of development or decadence of the eczema. The earlier writers of the present century held that a visible exudation or discharge was essential to constitute an eczema. More extended observation has led to the conclusion that this view is too restricted, and that the disease is often unattended with any visible exudation whatever. Eczema may consist of irritable red patches, or groups of scattered papules, or slightly raised and scaly spots, as well as of its more typical forms of vesicles or pustules with inflamed and excoriated surfaces; and any, or all, of these lesions may be present at one and the same time. This variable or polymorphic character of the disease is, indeed, one of its most distinctive and remarkable features. Eczema, as a rule, does not produce scars, and, as stated above, is non-contagious; nevertheless, *pustular eczema* is inoculable, and does occasionally, though very rarely, produce superficial scars.

Subjective sensations are always present in eczema, though they vary much in degree. Large excoriated surfaces give rise to severe smarting and burning pains, while the drier forms of the disease are often associated with intolerable itching, which is aggravated on exposing the skin to the air, and also at night. There is no part of the surface of the body which is exempt from attacks of this malady; it is, however, especially liable to appear on the flexor sides of the limbs and about the mucous orifices; in infants, the head is the part most commonly affected. Eczema attacks the skin for the most part symmetrically; it is, for example, rare to find one member suffer and the opposite member entirely escape. There are few exceptions to this rule, unless the inflammation is kept up on one side of the body by some purely local cause, such, for example, as varicose veins in the leg.

Etiology.—Eczema is by far the most common disease of the skin, and is met with at all periods of life from infancy to old age. It is rather more common in males than in females. The causes of eczema may, for convenience, be divided into (1) general or constitutional, and (2) local; of these causes the former are the more important. Most observers recognise the existence of what is called an hereditary tendency to this disease, but when we have to deal with a malady which is so common as eczema, it is not easy to arrive at an exact conclusion as to the degree of heredity; few families are entirely free. That some individuals have a strong tendency to attacks of eczema, and that others have no such tendency, is undoubtedly true, but the origin of this disposition or diathesis is often very obscure. The *exciting causes* of the disease vary somewhat with the age of the patient. In infancy there are three well-recognised and common causes—(1) the process of teething, (2) injudicious feeding, and (3) too frequent washing. In childhood especially, improper food plays an important part in the perpetuation, if not in the production, of eczema. Apart from an injudicious diet, a weak and imperfect digestion is a fertile source of chronic eczema in those who are predisposed to it. Constipation, and a general neglect of the action of the bowels, is another cause likely to perpetuate the malady. The most common exciting cause is, however, anxiety and mental worry, acting probably through the organs of digestion and assimilation. Among the less-defined exciting causes may be mentioned overwork, prolonged lactation, and the abuse of alcohol.

The best known local causes of eczema are (1) the application of irritating substances to the skin; this is met with in certain trades, such as those of barmen and bricklayers, where the hand is brought into frequent contact with irritating matter. Another example is seen in the effect of the aniline dyes on some sensitive skins. (2) Excessive sweating is very apt to produce an eruption of papular eczema on the chest and back; this is commonly observed in stokers, and is occasionally seen as the result of a Turkish bath. (3) Exposure to the sun, particularly in the tropics, is a well-known exciting cause of an eruption similar to eczema. (4) Excessive washing, especially with medicated soaps, is perhaps the commonest of all local exciting causes of the malady. (5) Mechanical irritation from rubbing and scratching plays a very important part in the extension, if not in the production, of eczema.

The diseases with which eczema is sometimes complicated or associated are chiefly gout and rheumatism, bronchial affections, and especially asthma, dyspepsia and catarrh of the stomach, boils, and varicose veins. Sometimes eczema alternates with attacks of gout, and at other times both are present at the same time; similar remarks apply with regard to asthma and stomach catarrh. Boils are often a troublesome complication, but usually yield to the kind of treatment which is suitable for the eczema, though in some instances they last for a long time after the latter is cured. The presence of sugar in the urine is very common in these cases.

Differential Diagnosis.—A typical case of eczema cannot be mistaken for any other disease. Acute eczema of the head, in which there is much swelling of the face and closure of the eyelids from infiltration, bears a very close superficial resemblance to erysipelas, and is often mistaken for it; in erysipelas, however, at the outset, the eruption is often one-sided, and the temperature is always relatively high; the pulse is quicker, and the tongue more furred than in acute eczema. Again, in erysipelas there is always loss of appetite, headache, and often wandering delirium at night. Acute eczema of other parts of the body is less likely to be mistaken for erysipelas. Dry, scaly spots of eczema, especially when they occur on the extensor sides of the limbs, are easily mistaken for poorly-developed spots of psoriasis; a previous history of eczema or psoriasis may aid the differential diagnosis in this case.

An acute or subacute attack of eczema of the palm often gives rise to the formation of blebs; this must not, of course, be confounded with pemphigus.

A dry and cracked eczema of the palm is often miscalled *psoriasis palmaris.* Strictly speaking, there is no such thing as psoriasis palmaris—that is, psoriasis which is limited to the palms; but eczema affecting the palms only is common enough, and from its dry and scaly appearance it is naturally mistaken for psoriasis; but sufferers from this malady, if they subsequently develop any eruption on other parts of the body, almost always develop eczema, and not psoriasis. Dry eczema of the palm may be distinguished from the well-known syphilitic eruption which it closely resembles (1) by the itching which is always present, (2) by the fact that it generally attacks both hands at the same time, (3) by the absence of any syphilitic eruption or symptoms in other parts of the body. For the differential diagnosis between eczema and 'the itch,' *see* SCABIES.

The question is often asked of the surgeon, Is it always safe to cure eczema? In discussing this question it is admitted that an obstinate eczema sometimes disappears almost suddenly, and that coincidently with this disappearance of the eruption there may appear a catarrh (possibly an eczema) of the stomach, bowels, or bronchial tubes; it is reasonable, therefore, to ask—Is this so-called metastasis the result of treatment? We have the following reasons for believing that it is not:—(1) It sometimes happens in cases of eczema that are not under any treatment whatever. (2) It also occurs where the treatment has been of the simplest kind, and not altered perhaps for weeks before the metastasis occurs. (3) The same changes in the eczema often take place at the onset of well-defined febrile disease, such as measles, which could not be produced by any treatment, however heroic. (4) The disappearance of the eczema often distinctly follows (not precedes) the disturbance of the mucous membrane. Altogether, the cases in which the treatment has anything to do with the metastasis are so rare that they may be left out of practical consideration. But in cases of this kind, whether or not the cure of an eczema has caused internal catarrh, it is certainly both easy and wise to start the eczema again over a limited area by means of counter-irritants, and thus relieve the internal organs. Those who have had the largest experience in the treatment of eczema agree that they have more cause to regret the inefficiency of their remedies, than reason to fear their potency.

ACUTE ECZEMA.—*Treatment.*—The general treatment of acute eczema is simple and does not admit of much variation. In severe cases, where a large surface of skin is involved, the patient must be confined to the bed or couch; as the more acute symptoms pass away this rule may be relaxed. Free purging is always an essential part of the treatment, unless some exceptional circumstances contraindicate it. The best purgatives are sulphate of magnesia or sulphate of soda, or some of the natural mineral purgative waters in common use. When the attack is distinctly of gouty origin, the purgative treatment should be supplemented by the administration of alkalies, either with or without colchicum, according to circumstances. In the *local treatment* of acute eczema, ointments, especially those of a stimulating kind, must be strictly avoided. Usually the best and most soothing treatment is by water dressing, or a weak lead lotion may be used instead of water; but in no case must the dressing be allowed to get dry. During the daytime, when the dressing can be easily kept moist, it is usually better not to cover it with thin gutta-percha or oil-silk, but at night this plan may be adopted, in order to prevent the lint drying quickly. Some patients derive more comfort from linseed-meal poultices, which have the advantage of retaining the moisture longer than water dressing; otherwise the principle of treatment is the same in both cases. When the acute symptoms have a little subsided, the linimentum calcis may be used.

Sub-Acute or Chronic Eczema.—The *general treatment* of sub-acute or chronic eczema is more or less common to all forms of the disease, and is independent of the particular region attacked; the *local treatment*, on the other hand, requires special adaptation to the stage of the inflammation in the part affected. In determining what form the general treatment should take in any particular case, it is necessary first to find out whether there is any other disease present which may tend to modify our treatment or guide it into the right channel. For example, when an attack of eczema is associated with gout or dyspepsia, the best plan of treatment is to cure the gout or dyspepsia, and treat the eczema by local means alone. In the great majority of cases, however, eczema exists as a malady *per se*, and is uncomplicated with other diseases. Under these circumstances, arsenic is by far the most valuable remedy, and this is especially the case when the patient is young. The best mode of administering arsenic in chronic eczema is, to give small doses with alkalies and some aromatic or bitter infusion just before or after each meal. Sometimes the mineral acids, combined with arsenic, are more beneficial than alkalies; no definite rule can be given on this point, but usually when the tongue is furred alkalies suit best. In children between the ages of one and three years one-drop doses of liquor arsenicalis three times a day are usually sufficient. The routine practice of treating eczema at this age with cod-liver oil and vinum ferri generally ends in failure, particularly when the eczema is of an irritable kind; in cases, however, where iron is especially indicated, the arsenic may be combined with the vinum ferri or the syrupus ferri phosphatis. In all forms of eczema great attention should be given to the proper action of the bowels; the malady is not infrequently associated with constipation, even in those who are not usually constipated, and unless this be overcome all other treatment will fail. The best form of purgative will vary with the circumstances of the case and with the age of the patient; in infancy, fluid magnesia in milk is one of the best; in childhood, sulphur powders in milk, or some effervescing saline purgative, are most suitable. In middle life, a morning draught, containing sulphate of magnesia or sulphate of soda, with some aromatic or tonic effusion, is usually the best form of purgative. Lastly, in old age, an aloetic pill at night is indicated.

Diet.—A well-regulated diet is of the first importance in the treatment of eczema. By a well-regulated diet is not necessarily meant a very abstemious diet; whether the diet should be abstemious or not will depend on the circumstances of the case. For example, pustular eczema in children generally requires a liberal meat and fish diet, with beer or wine; on the other hand, a dry, irritable, gouty eczema in the middle-aged is often benefited by a reduction in the usual amount of meat and stimulants. There are, however, certain kinds of food which are generally objectionable in eczema of all kinds and at all ages; these are coffee, sugar in all its forms, highly salted meat, and red pepper.

Local Forms of Eczema.—*Eczema of the Scalp.*—In severe cases of eczema of the scalp, especially in children, the hair should be cut short and the head well oiled, and covered with a warm poultice for a few hours so as thoroughly to soften the scabs. The scalp should then be well fomented and cleaned with warm water. When all the crusts have been carefully removed, the head should be thoroughly dried, and when quite dry, dressed with an ointment consisting of acetate of lead gr. x., zinc ointment ʒij., calomel gr. xx., nitrate of mercury ointment gr. xx., vaseline ʒij., benzoated lard ℥ss.; or the white precipitate ointment diluted with an equal quantity of lard or vaseline may be used. When the eczema is of a very chronic, dry, and scaly kind, with no tendency to discharge, the best application is the red oxide of mercury ointment one part, vaseline or benzoated lard three parts. If the eczema of the scalp is subacute instead of chronic, and the head hot and irritable, a lotion should be used instead of an ointment; the head should be covered with lint soaked in lead or sulphate of zinc, or weak carbolic acid lotion (1 in 100). The lint should be kept in position by means of a thread or cotton nightcap; when the inflammation and discharge have subsided an ointment may be used.

Eczema of the Nostrils.—If any crusts are present, they should be removed by means of oil and warm water. Subsequently the diluted citrine ointment, made quite soft, should be carefully introduced with a small camel's-hair brush night and morning.

Eczema of the hairy parts of the Face. This is one of the most troublesome forms of eczema to deal with locally. All crusts should be carefully removed by means of oil and warm water, or a poultice may be used for an hour or two to soften them. In severe cases the hair must be cut short with a sharp pair of scissors, but never shaved. If the eczema is pustular, it is generally better, after the crusts have been removed, to dry it up as quickly as possible by painting the skin with a calamine and oxide of zinc lotion. The crusts, under this plan of treatment, form again quickly and must be again removed in a day or two by means of warm water as before; but, as the eczema improves, the crusts should be removed less frequently, especially when they are firmly attached to the skin. The hairs which pass through pustules should be pulled out; they come out easily and almost without pain, a little pus escaping. In dry forms of eczema of the hairy parts, the diluted citrine or red oxide of mercury ointment is usually the best local application.

Eczema of the Auditory Meatus.—Any crusts should be removed by syringing with warm water; this should be followed by using, two or three times a day, a tepid sulphate of zinc lotion (gr. iij.–vj. ad f℥j.), or a weak carbolic acid injection (1 in 100) may be used. In some instances the injection of a nitrate of silver lotion (gr. iij.–iv. ad f℥j.) is useful, or a rather stronger solution may be painted over the walls of the meatus by carefully inserting a camel's-hair brush. When the eczema is of a dry kind, or when all discharge has ceased, citrine ointment, diluted with four parts of oil or vaseline, is the best local remedy; it should be inserted with a small camel's-hair brush or dropped into the ear.

Eczema of the Scrotum, Labia, and Anus.—In dealing with subacute eczema in this region, the parts should be kept covered with lint well soaked in lead lotion. A pair of thin cotton bathing drawers will often be found useful in keeping the dressing in its place. As soon as the more acute symptoms have passed away, the parts may be dressed with either zinc ointment or with the compound lead ointment of the old London Pharmacopœia, made quite soft by the addition of more oil. The addition of a small quantity of tar or creosote ointment to either of these is very useful in dealing with chronic eczema about the anus. In *pruritus ani*, which is generally a form of undeveloped eczema, it is best to sponge the parts freely with a strong lead or boracic acid lotion, to which has been added two or three per cent. of the liquor carbonis detergens; the parts should then be dabbed dry with a handkerchief, and some ointment applied. In pruritus of the labia, painting with a solution of nitrate of silver (20–30 gr. to f℥j.) generally gives relief.

Eczema of the Legs.—The special indication in the treatment of chronic eczema of the legs is always to bandage them when this is possible; it has the double advantage of keeping the dressing in its proper place, and at the same time exercising a little pressure on the superficial vessels of the leg, which is very beneficial in most forms of eczema. Sometimes the solid india-rubber bandages are very useful, but they do not suit all cases.

Eczema of the Hands and Feet.—Chronic eczema of the hands, especially of the palms, is one of the most obstinate forms of the malady. This arises (1) from the natural thick condition of the cuticle, which becomes brittle and cracks with the movement of the parts, leaving troublesome fissures; (2) from the functions of the organ, which is never at rest and frequently washed, both which conditions are very unfavourable to the cure of eczema. Therefore the first rule is to rest the hand as much as possible, and to forbid all ordinary washing with soap and water. Soft gloves should be worn constantly during the day; this serves the double purpose of keeping the hands clean and the dressings closely applied. The lead ointments, or oleate of zinc ointment (ʒij. ad ℥j.), are very useful in the treatment of this form of the malady. In some very chronic cases, where the cuticle is much thickened, a saturated solution of salicylic acid in flexile collodion is an excellent dressing for removing the hard cuticle; subsequently, when this is thoroughly removed, the hand may be dressed with some oleate of zinc ointment in the usual way. India-rubber gloves and fingerstalls are sometimes useful in the treatment of chronic eczema of the hand. As a rule, eczema of the feet should be dealt with in the same way as eczema of the hands, but the toes should always be kept apart with small pieces of lint. Fissures both in the hands and feet are best treated by painting along the bottom of the fissure a solution of nitrate of silver with a very fine camel's-hair brush. In acute eczema of the hand, the arm must be placed in a sling and the hand dressed in the usual way with water dressing, followed by linimentum calcis.

Eczema of the Nipple.—Paget's disease of the nipple was, until lately, regarded as a form of obstinate or incurable eczema ; it is now, however, generally believed to be a form of inflammation distinct from eczema. *See* Nipple, Diseases of the.

Washing in Eczema.—In the treatment of eczema, perhaps more mistakes are made with regard to washing than on any other point. In all cases of eczema, except those that are very chronic and psoriasis-like, ordinary washing with soap and water must be strictly forbidden; and, in the case of infants with general eczema of the body, all bathing must be discontinued. The new and delicate cuticle which forms over a healing eczematous surface is quickly macerated and destroyed by water, and thus the process of healing is indefinitely prolonged. Robert Liveing.

ELBOW, Diagnosis of Injuries and Diseases of the. *See* Arm and Forearm.

ELBOW, Excision of the. *See* Joints, Excision of.

ELBOW-JOINT, Amputation at the. Amputation at the elbow-joint is one not often selected by surgeons, although some operators of eminence, notably Professor Gross, have expressed themselves strongly in favour of it.

In performing the operation, difficulty may be avoided by bearing in mind the oblique direction of the articulation, such obliquity arising from the inner condyle being lower than the outer, the difference in level being nearly half an inch.

The operation may be performed by

I. The antero-posterior flap method (Dupuytren).

II. The single oval flap method (Baudens).

III. The circular method (Velpeau).

IV. Long anterior flap (Malgaigne).

V. Single lateral flap (Stimson).

VI. Double lateral flaps.

VII. Long single posterior flap (Holmes).

VIII. The rectangular method (Teale).

Of these methods the first and the third appear to the writer to possess the greatest merit. The former may be done either by transfixion or by cutting from without inwards. The anterior flap, at least two and a half or three inches in length, should have for its base a transverse line drawn three-quarters of an inch below the condyles. In making this flap the forearm should be flexed, so as to bring the articular surface of the humerus on a line with the edges of the coronoid process. Some operators make the base of the flap on a level with the condyles ; but the advantage derived from making the base at the situation already indicated is, that the risk of subsequent projection of one or other of the condyles through the wound is diminished. The joint is then opened, the ligaments connecting the radius and ulna with the humerus being divided, and the triceps is then detached close to its insertion. The posterior flap is formed by passing the knife behind the olecranon and head of the radius, and cutting from within outwards ; or the division of the structures forming the posterior flap may be effected by cutting from without inwards. The posterior flap in large muscular subjects may also be made by transfixion. Leaving the portion of the olecranon to which the triceps is attached was a method recommended by Dupuytren, with the view of minimising interference with that muscle. This can be effected with either bone-forceps or a small resection saw. Velpeau was opposed to this modification, but it has been warmly advocated by Gross, who also, to improve the shape of the stump, states that the 'inner trochlea' may be cut off on a line with the other surface.

In operating by the circular method, the incision should commence at least three inches below the condyles. This incision must not involve more than the skin, which should be dissected back half the length of the flap. The superficial muscles should be divided and retracted, and then the deeper ones. Next, the articulation—as in the previous operation—should be opened, and disarticulation effected. In this operation—in the writer's opinion the one to be preferred—the edges of the flap can be brought together, so that union may take place either in a horizontal direction, or from before backwards. The latter plan is usually adopted, as the cicatrix then falls between the condyles. Another plan, which has the alleged special merit of promoting facilities for drainage, consists in uniting the edges of the wound somewhat in the form of a leech-bite, a method the older surgeons used to advocate in other amputations.

The single and double lateral flap methods do not appear to possess any special advantage over those already mentioned. In operating by the first of these Stimson recommends the external flap, which should be four or five inches in length, to be 'made by transfixion from a point in the middle line, in front, a finger's breadth below the bend in the elbow; or from without inwards by an incision beginning at the same point and ending half an inch higher on the posterior face of the ulna. A second incision is made transversely across the inner side of the arm about an inch below the upper end of the first. The radio-humeral joint is opened, and the disarticulation completed.' Mr. T. Holmes has performed the operation by making a long skin flap from the back of the limb, a transverse incision dividing the anterior tissues, and the resulting stump was satisfactory.

The statistics of the operation when performed in cases of extensive injury, such as are produced by gunshot wounds, are not unfavourable. In the American war it was ascertained that there had been thirty-nine cases, with only three deaths, giving a mortality of 7·6 per cent.

William Stokes.

ELBOW-JOINT, Diseases of the.—This joint is frequently the seat of both acute and chronic inflammation; the acute being usually rheumatic, traumatic, or septic, the chronic most often being of scrofulous origin.

Acute synovitis of the elbow gives rise to pain, heat, swelling, and restricted mobility. The swelling is most manifest at the back of the joint, where it obscures the natural outline of the olecranon; pain is much increased by movement, especially in the direction of extension.

The first essential of *treatment* is to ensure rest to the joint, by fixing it to a splint, which is most comfortably applied on the inner aspect of the limb; the forearm should be flexed to rather less than a right angle, and in a position of semi-pronation. If the inflammation be very acute it is best to keep the patient in bed, and to place the arm on a pillow or swing it in a cradle; in less severe attacks the arm can be supported in a sling, and the patient allowed to be up. Leeches, cold, or other antiphlogistic remedies, can thus be easily applied.

Rheumatic inflammation in this, as in other joints, is very apt to lead to firm adhesions; and it must be remembered that the utility of the limb, should ankylosis occur from any cause, will depend greatly upon the position in which the joint becomes fixed, which should always, if possible, be at rather less than a right angle.

Chronic inflammation of the elbow-joint is attended with the usual thickening of the synovial membrane, which can be felt as an elastic swelling, filling out and obliterating the natural hollows of the joint. It is frequently of scrofulous origin, and then tends to progressive degeneration of the synovial membrane, destruction of the cartilages, and caries of the surface of the bones; or the disease may begin as an articular ostitis. When suppuration occurs, and matter makes its way to the surface, much inflammatory growth takes place in the tissues around and outside the joint, accompanied with corresponding wasting of the muscles.

Treatment.—In the earlier stages of simple chronic inflammation of the elbow, much good may be obtained from repeated small blisters, the actual cautery lightly applied, and the inunction of stimulant ointments. But when suppuration has occurred and the bone-ends are exposed and carious, as so often happens in the scrofulous cases, it is better as a rule to resort at once to excision; for the results of this operation are usually so satisfactory, and the utility of the limb so much greater than if ankylosis results, that it is justifiable at a much earlier stage of treatment than in the lower extremity.

Loose cartilages are occasionally met with in the elbow-joint, but are not usually productive of sufficient inconvenience to call for removal.

Osteo-arthritis also affects the elbow, giving rise to aching pain, impaired movement, crepitation in the joint, and alteration of the shape of the bones. Warmth, friction, the douche, and the internal administration of fatty foods do good in the earlier stages of the disease. Splints and apparatus of restraint should be avoided.

J. Warrington Haward.

ELBOW-JOINT, Dislocations of the. Dislocations of the elbow-joint, unlike other dislocations, are common in young persons, usually in boys between the ages of ten and fifteen, but are most frequent between the ages of fifteen and thirty-five. Displacements at the elbow include dislocations of the radius and ulna together, or of either bone separately. The former only will be described as dislocations proper of the elbow-joint.

The bones of the forearm, held together at their upper extremities by the orbicular ligament, may be dislocated in four principal directions—*backwards, forwards, outwards*, and *inwards* — the enumeration being given in the order of their relative frequency.

DISLOCATION BACKWARDS includes three varieties—(1) the dislocation *directly backwards*, which is by far the most common displacement at the elbow-joint; (2) *backwards and outwards*; and (3) *backwards and inwards.*

(1) *Dislocation directly backwards* is usually caused by falls on the palm (in boys often occasioned by leap-frog), and sometimes by blows on the back of the arm when the hand is fixed. The symptoms are fixation of the forearm at an angle of from 135° to 115°, and pronation of the hand. The forearm is shortened, and at the bend of the elbow is a rounded projection caused by the lower end of the humerus pressing forward the brachialis anticus and biceps muscles. Behind, the olecranon projects as a sharp angle, to the extremity of which the outline of the triceps may be traced, whilst on either side of this muscle there is a well-marked depression. The cup-shaped head of the radius may be seen and felt immediately behind the humerus on the outer side, and be made to rotate during pronation and supination. The amount of displacement backwards and upwards varies in different cases. According to Malgaigne, the most common dislocation is an incomplete one, the tip of the coronoid process lodging beneath the trochlear surface, the olecranon remaining about on a level with the condyles of the humerus, and the cup of the radius being only partly felt beneath the skin. This scarcely accords with general experience. In many cases—probably the majority—the coronoid process drops into the olecranon fossa, or at least lies behind the trochlear surface; and in a few this process has been found drawn up above the fossa, when dissected after death.

Some resemblance exists between the appearance of supra-condyloid fracture of the humerus and dislocation backwards at the elbow, but the distinctions between them are not difficult. In fracture the anterior prominence is angular and just above the bend of the elbow, so that the forearm is not shortened. The posterior projection is less angular and includes the condyles, to which the radial head and olecranon bear their normal relations. The movements of the joint can be obtained, though limited by pain. Crepitus is elicited on extension. Measurement between the external condyle and tip of the olecranon, which in dislocation is increased, in fracture is normal; and the distance between the external condyle and acromion, which in dislocation is normal, is shortened by fracture. Lastly, the deformity may be made to disappear under extension, but has a tendency to recur as soon as extension is relaxed.

Blood-effusion into the bursa over the extremity of the olecranon causes a projection at the back of the elbow not unlike dislocation backwards, and the writer has known this condition mistaken for dislocation, and force applied with a view of reducing it. The freedom of the movements of the elbow will serve to distinguish this accident from one of luxation of the joint.

The effect of dislocation backwards is to cause rupture of the anterior and lateral ligaments, laceration of some of the fibres of the brachialis anticus, together with a displacement forward of this muscle, the biceps, the brachial artery, and median nerve. In children, partial or complete separation of the epiphysis of the humerus may be a complication, and a very careful prognosis as to the future of the joint is in these cases necessary. Fracture of the coronoid process of the ulna is a complication occasionally met with, which may render the dislocation easy to reduce but difficult to retain in position. It was found associated with a vertical fracture of the head of the radius in a dislocation caused by a fall from a great height, the specimen of which is in the Museum of St. George's Hospital. The radius and ulna have been occasionally found dislocated backwards, but separated from each other.

Reduction of dislocation backwards is not often difficult. It may be effected in many cases by simply pressing the humerus back with one hand, whilst extension is made at the wrist by the other. Where more force is required pressure with the knee is usually employed. The patient sits in a chair, and the surgeon, resting his foot on the seat beside him, places his knee in the bend of the dislocated elbow; then, seizing the arm with one hand and the forearm with the other, he bends the joint across the front of his knee, and the bones slip into position. Some, with Guy de Chauliac, consider the pressure should be directed against the humerus, others follow Astley Cooper in pressing chiefly upon the bones of the forearm. The effect of force in the latter direction will be to draw the bones of the forearm below the humerus, and in the former to press the humerus back over the coronoid process. It is probably better that these two objects should be carried out simultaneously. A modification of the same method is to carry the arm round a post or through the back of a chair, and then make traction and flexion. In any case of difficulty the surgeon should employ an anæsthetic.

(2) *Dislocation backwards and outwards* is caused by the patient falling first on his palms, then on the inner side of his forearm, by which means the bones are carried first backwards, then outwards. The forearm is semiflexed, shortened, and usually strongly pronated, but in a case recorded by Velpeau it was said to be supinated. The coronoid process is lodged behind the capitellum, and the radial head projects behind and external to the outer condyle, there being a deep hollow above it, whilst the inner condyle is unduly prominent, and the olecranon projects boldly behind. A typical case observed and sketched by the writer occurred in a boy aged ten, who, when running at the game of ‘touch,’ was tripped up by one boy and fallen upon by another. The dislocation was easily reduced by extension and manipulation. It would seem reasonable to attempt to press the bones inwards before using traction to bring them forwards into place. In a case related by Debruyn, where forcible traction combined with flexion was tried on more than one occasion, the result was to convert the dislocation into one directly outwards, but no force would reduce it inwards. Amputation became necessary, and the brachialis anticus, biceps, artery and nerve were found behind the external condyle, the nerve and vessel having been ruptured by the attempts at reduction.

(3) *Dislocation backwards and inwards* is usually caused by a fall, in which the weight of the body is received first on the palm, then on the outer edge of the forearm or elbow, so that the bones are carried first backwards, then inwards. It has also been caused by a fall on the back of the wrist and forearm. The forearm is slightly flexed, shortened, and usually supinated. The external condyle is abnormally prominent, whilst the internal is obscured. The coronoid process is lodged at the back of the internal condyle, and the radial head rests behind the trochlea. The olecranon projects posteriorly, and is at a greater distance than normal from the external condyle. Astley Cooper, who first described this dislocation, reduced his case by forcible extension, when, he remarks, the brachialis anticus and biceps pressed the humerus back into position. It would appear advisable to press the ulna outwards before making extension, in order that the coronoid process may pass round the projecting margin of the trochlea before being drawn forward. However extension is made, it is probable the bones will tend to travel back along the same track by which they escaped.

Dislocation forwards is rare, but rests on well-authenticated cases. It is caused by falls on the elbow when the forearm is flexed. The olecranon passes forward and lodges on the anterior surface of the trochlea, in consequence of which the forearm is lengthened to the extent of this process. The head of the radius can be felt anterior to its normal position, and there is a fossa between it and the humerus. The condyles of the humerus are more prominent than usual, and there is a depression between them where the olecranon should be lodged. Generally the forearm has been found flexed and supinated, but in one case extended. In a case of complete dislocation recorded by Monin, the bones of the forearm rose in front of the humerus, causing the upper arm to appear shortened. If the forearm be extended, the coronoid process and head of the radius distend the skin in front of the elbow. Reduction is to be accomplished by flexion of the forearm on the arm. In a case of difficulty an assistant should fix the hand whilst the forearm is flexed, and the surgeon, locking his hands on the upper part of the forearm in front, and resting his thumbs on the condyles of the humerus behind, should draw the bones of the forearm downwards and backwards, at the same time that he presses the humerus forwards with his thumbs.

Dislocation outwards is more frequent than dislocation inwards, owing to the latter being in a great measure prevented by the prominent inner margin of the trochlear surface. It is caused by a fall on the inner side of the forearm and elbow, or by a blow on the outer side of the humerus when the forearm is fixed. A case recently seen by the writer, in a man aged twenty-four, was caused simply by slipping off the curb and falling on the inner side of his elbow. The ulna is carried outwards, so that its greater sigmoid cavity rests between the outer margin of the trochlea and the capitellum, whilst the radial cup projects below and external to the outer condyle. The forearm is semiflexed, displaced outwards, and strongly pronated, whilst the inner condyle is abnormally prominent. The dislocation, as described, is complete only as regards the radius and as a luxation of the elbow-joint is *incomplete*, but very occasionally the ulna passes external to the capitellum, and the dislocation is then *complete*. Reduction is usually easy. The forearm should be seized at the wrist with one hand and supinated, by which means the pronator teres is made to draw the bones of the forearm towards the inner condyle; at the same time the elbow is grasped by the other hand in such a way that the fingers are used to draw the radius and ulna inwards, whilst the thumb presses the inner condyle outwards. Failing this, the knee may be applied over the inner condyle, whilst the forearm is supinated and drawn inwards.

Dislocation inwards is usually caused by a fall on the outer side of the elbow. The greater sigmoid cavity of the ulna embraces the under surface of the internal condyle, and the radial head lies against the inner margin of the trochlea. It is, therefore, incomplete. The forearm is slightly flexed, directed inwards, and pronated. The external condyle is unduly prominent and the internal obscured. To reduce this form of displacement the upper arm and hand should be fixed by assistants, and the surgeon should then draw the bones of the forearm outwards with one hand, whilst using the other to press the humerus inwards.

In a few cases the ulna has been found dislocated backwards, at the same time that the radius was dislocated forwards.

For the dislocations of the radius or ulna singly at the elbow *see* Radius; Ulna. R. Clement Lucas.

ELECTROLYSIS.—The chemical decomposition produced by the passage of electricity may, under certain conditions, be applied to the treatment of disease. All forms of electricity cause electrolysis, and, although the voltaic current is at present the most convenient and effective, it is likely that other modes of developing and storing electricity may ultimately be preferred. The amount of decomposition is proportioned to the *intensity* of the current, that is, the quantity of electricity which passes through the electrolyte. The intensity is determined by the amount of electricity generated, and by the resistance offered to its passage. This resistance, inversely correlating the power of conduction, is composed of external and internal resistance, or that which lies in the electrolyte and conducting wires, and that which resides in the battery itself. Hence Ohm's law $I = \frac{E}{R_1 + R_2}$, in which I = intensity, E = electromotor force, R_1 = external, and R_2 = internal resistance. It is evident, therefore, that the work done will largely depend on the relative value of R_1 and R_2. If R_1 be relatively great, means must be taken to increase the penetrating power or tension of the current. This is done by multiplying the cells of a battery. On the other hand, R_2 is diminished by increasing the size of the cells. By reference to these facts we determine the form of battery to be used in the different applications of electricity in medicine and surgery.

In the process of decomposition by electricity there are two actions. One consists in the primary separation of the electrolyte into its components. These appear at the poles of the battery, that is, at the points where the conducting wires come in contact with the electrolyte. The substances which appear at the positive pole are called electro-negative ions, at the negative pole electro-positive. The same substance may vary in this respect according to its associations, but in a general way it may be said that oxygen, acids, and their allies appear at the positive, while hydrogen and bases appear at the negative pole.

The second action consists in the chemical changes which these nascent products bring about in their surroundings.

In organic electrolytes this secondary electrolysis is more important than the primary. Theoretically we should expect, and practically we find, that the effect of electrolysis on the tissues is mainly due to the chemical action of the nascent ions. With blood as the electrolyte, there is produced at the positive pole a tolerably firm dark coagulum adhering strongly to the electrode and of acid reaction; at the negative a pinkish white somewhat sticky froth, enclosing bubbles of hydrogen, while the remainder of the blood, according to the strength and duration of the current, assumes more or less the appearance and consistence of thin tar. On the solid textures a similar acid and alkaline reaction is produced, viz. at the positive pole a dry slough of small size with a contracting cicatrix, at the negative a livid, large, diffuse, soft eschar, the one resembling the effect of nitric acid, the other of caustic potash.

Therapeutic Uses.—Electrolysis has been employed for the cure of aneurism, for the destruction of tumours and other morbid products, and for the disintegration of urinary calculi.

Aneurism.—In aneurism our aim is to coagulate the blood in the sac. We may desire to accomplish this end at once, or we may think it better to produce only a small quantity of coagulum for the purpose of provoking the subsequent deposition of laminated fibrin. On this point there is divergence of opinion. Experience shows, however, that it is not more dangerous to attempt the full coagulation ; and since deposition of fibrin subsequently is at least as likely after such an attempt, the bolder appears the better method. In most cases, however, it will be found impossible at once and permanently to occlude an aneurismal sac. It has been done, but the rule in successful cases is, that pulsation recurs for a time, even after its complete abolition. The froth occupies less space as the gas becomes absorbed, and the living current is again admitted in so far as the aneurismal wall may not have contracted with corresponding rapidity.

The constant current from a battery of considerable electromotor force should be used, that the work may be done in a reasonable time. Blood is a good conductor. The greatest amount of work, therefore, with the least shock and pain to the patient, is got from three to six cells of a size between those used for the cautery, where quantity is desired, and the ordinary medical batteries, where tension is necessary to overcome the resistance of the cuticle. As the effect is produced only at the point of contact, it is necessary to introduce needles into the blood. One needle should be connected with each pole. A larger number increases the risk of irritating the sac. Success has followed the insertion of one pole only,. while the other has been applied to the skin ; but with both poles inserted, the work done is more effective and accurate, and is painless. The needles should be insulated where they lie in contact with the tissues, to prevent pain, inflammation, and risk of hæmorrhage. Vulcanite was found many years ago by the writer and Dr. Fraser to be by far the most convenient insulator. The needles are usually made of steel; but to avoid destruction by acids, the one attached to the positive pole may be made of platinum or gold. The duration of the operation will be determined by the effect produced in diminished pulsation and increased tension through the formation of gas. From half an hour to an hour and a half is necessary.

If the operation be properly performed, it is free from risk. Inflammation of the sac is prevented by taking care that the exposed point of the needle does not touch it. Embolism has never occurred, and the hæmorrhage from the needle punctures is easily checked by gentle pressure, if the puncture be made where the wall is thick.

This operation has been most frequently used in aortic aneurism, after the failure of other treatment. In some cases, chiefly Italian, complete success has been attained; in others, marked amelioration. The writer has not been fortunate in obtaining a cure in aortic aneurism, but in several instances has averted for long periods impending death from external hæmorrhage, and has frequently produced diminution of size and amelioration of symptoms. On the other hand, in one or two instances he has thought that more rapid spread internally has followed the occlusion of the external sac by electrolysis.

In surgical aneurism it has been fairly successful, but it cannot be preferred to compression or ligature, and although safer in most cases than opening the sac, and in all than coagulant injections, such opportunities for its use do not frequently occur.

Blood-tumours.—In these forms of disease electrolysis finds its most complete success. It brings about a cure first by cauterising the tissues, and secondly by causing directly and indirectly coagulation of the blood. These products are then slowly absorbed. To get its best results it is absolutely necessary, by insulation of the needle and care in operating, to guard against the slightest cauterisation of the skin. Then the infinite division of the caustic prevents it from being carried into the circulation, its nascent form insures its energy, and its perfectly subcutaneous action avoids all possibility of inflammation or hæmorrhage, and all trace of scar.

For cirsoid aneurism it is the treatment *par excellence.* With perseverance and decision it will not fail. In aneurism by anastomosis it is less certain. It is difficult to occlude the huge caverns communicating with large veins and arteries so perfectly as to prevent the blood finding its way into them. It can be relied on only in examples of small size.

Whenever it is important to cure a nævus without a scar, electrolysis is absolutely certain and perfectly safe. The objection is that it is slow. Several operations are generally required, and it is of little use operating under intervals of six weeks. As much induration should be produced at a sitting as is possible without injuring the skin, or so overtaxing the absorbents as to lead to suppuration. With these precautions and perseverance, the effect is admirable in safety, precision, and absence of mark or scar. It is of course impossible by this or any other method to cure a simple port-wine stain without leaving traces of operation. It is to the subcutaneous and partly subcutaneous forms that the operation is applicable.

Goître.—The vascular kind of goître is amenable to electrolysis. The operation requires frequent repetition, but is probably as safe and effectual as any other form of local treatment. If the tumour be causing symptoms too dangerous to brook delay, electrolysis must give place to excision. It is not to be relied upon in the cystic and fibrous varieties.

It has been employed by Schuh and others in varix. It will cure, but is inferior to other plans of treatment.

Solid Tumours.—The use of electrolysis proposed by Beard and Rockwell for the open as distinguished from the subcutaneous removal of abnormal growths, presents no advantage whatever over other methods by knife, cautery, or caustic. Consequently, after several trials, the writer has abandoned its use for malignant tumours, even when they are highly vascular. On an average the increased growth produced by irritation outweighs the absorption of the part destroyed. Doubtless electrolysis is capable of procuring the disappearance of many simple tumours, but in most it is less certain, far more tedious, and, from the necessity of anæsthetics on each occasion, not more safe than the knife. In some chronic hypertrophies and inflammations, however, it may often be useful. If pus have not already formed, and there be no persistent local cause, enlargement of lymphatic glands may be treated by electrolysis perhaps as hopefully as by any other local application. Success has followed the use of electrolysis in hydatid and other cysts.

John Duncan.

ELEPHANTIASIS ARABUM. — *Definition.*—A chronic hypertrophy of the skin and subcutaneous tissue, occasioning enormous enlargement and deformity, the result of repeated attacks of inflammation of the lymphatics and skin.

The term 'elephantiasis' is generically applicable to any hypertrophy of the skin, to whatever cause it may be due, whether to varicose veins, chronic eczema, ulcers, lupus, or syphilis; or to any condition producing compression of the veins and lymphatics, such as exostosis, enlarged glands, bone-disease, or old-standing dislocation. It is equally applicable to any hypertrophically enlarged limb, though it be merely a congenital deformity. But although any of these local causes can produce elephantiasis—the hypertrophic condition of connective tissue and morbid anatomical appearances of which are identical with those observable in the disease under consideration—elephantiasis arabum signifies far more, and differs altogether from simple hypertrophy as seen in this country, while at the same time it must not be confounded either with elephantiasis græcorum, which is true leprosy, or with elephantiasis italica, another name for pellagra.

Elephantiasis arabum is dependent on a variety of climatic conditions, and is endemic in tropical countries, chiefly in India, China, Egypt, Arabia, Barbadoes, and other islands of the West Indies, and in South America. Some authorities believe that it is commonest near the sea-coast, others that it occurs in damp and humid regions, while others again hold that it is to be found most frequently in a malarious district. It is said to affect males rather than females, the poorer and ill-fed classes rather than those who, well-clothed and nourished, obey the ordinary hygienic laws of life. It is considered that the variety of elephantiasis arabum known as lymph scrotum most frequently attacks the natives who habitually wash in stagnant, dirty water, and that the legs are affected in those who walk barefooted. No race of men is entirely exempt from this disease, which is, however, far more common among the dark than the fair races, and but seldom attacks pure Europeans.

Course and Symptoms.—The disease is usually ushered in with fever—aptly called 'elephantoid'—resembling ordinary intermittent fever, in the regularity of its recurrence, sometimes at monthly intervals, but differing from it in its duration. Inflammation of the lymphatics, either preceding the fever or appearing at the same time, produces general swelling of the part attacked. The skin becomes red, tense, tender, and burning, often vesicles or bullæ are formed, which discharge a serous or chyle-like fluid, the attack presenting, as a whole, all the characteristics of an attack of erysipelas. The general constitutional symptoms accompanying the fever are, as a rule, headache, malaise, nausea or vomiting, and severe lumbar pains, with the addition of dragging and tenderness in the groins and spermatic cords when the scrotum is the seat of mischief. After awhile, both the fever and the local inflammatory symptoms disappear, and the patient is, for the time being, restored to health. At the end of this interval of rest the fever returns, together with a renewed erysipelatous attack of greater severity, the lymphatics becoming more involved, swollen, and twisted. Again the acute symptoms abate, but the affected part, though free from heat and pain, remains swollen and distorted. The meshes of the corium and subcutaneous tissue are distended with lymph, from which the connective-tissue elements draw excessive nourishment and become hypertrophied. The condition of the part after the first few attacks is like œdema from dropsy, causing pitting on pressure with the finger; but after several attacks of fever and local inflammation, the part feels dense and hard, and even much force will not produce the slightest indentation. After some years—Mr. V. Richards says as many as eleven and a-half—the attacks of fever cease, and the part becomes uniformly and permanently swollen. If the region affected be the leg, the appearance produced is one of monstrous deformity. For, although the enlargement rarely occurs above the knee, and there is always a constriction around the ankle, the foot and leg become one shapeless mass, like an elephant's leg, hence the name of the disease. The outline of the ankle is obliterated, no bones can be felt, and the toes are entirely hidden.

The severity of the constitutional symptoms varies; in some cases there is little or no rise of temperature, while in others the fever is intense. The pain also varies, being sometimes comparatively slight, in other instances so severe during the inflammatory attack as to prevent the patient walking. Itching is occasionally a great additional torture.

The appearance of the skin in the hypertrophic stage differs considerably in individual cases, and also in different parts of the same limb, At times, and in certain parts, it is hard, dark, and scaly, or again it may be smooth and tense, in which condition it is often attacked with eczema; or, yet again, it may be rough and tubercular. Another variety presents an appearance resembling ichthyosis, the epidermis being thickened and dirty-looking. Lymph may exude upon the skin from vesicles or small soft swellings, or the surface may be warty, or broken up by deep, foul, discharging ulcers.

Elephantiasis scroti generally commences, according to Pruner, in the form of a hard kernel under the skin, usually at the bottom of the left side of the scrotum, and is attended with severe fever and constitutional disturbance, similar to that already described. The skin becomes thickened, indurated, furrowed, and wrinkled. The abdomen alters in form, the skin being drawn down so as to assist in enlarging the scrotum. The penis also increases in size, but becomes hidden in the enormous overgrowth beneath it. As the tumour enlarges, which it may do to the size of 100 lbs. or more, the lymphatics become varicose and often burst, the discharge from them drying and forming crusts. A condition called 'lymph varix,' described by authors under various names, is said to occur chiefly in China, and is most often associated with elephantiasis scroti. It presents the appearance of a soft tumour which, when punctured, exudes a pinkish or whitish fluid like chyle.

The parts most commonly attacked by elephantiasis arabum are the leg, usually one only, and the external genital organs, male and female. It also assails the arms, scalp, ears, and tongue, showing a preference for the parts in the order named.

Morbid Anatomy and Pathology.—To the naked eye a section through a limb affected with elephantiasis arabum presents an appearance of layers of enormous thickening in the corium, subcutaneous tissue, fasciæ, and periosteum; and, while the bones are hypertrophied, the muscles are wasted from long-continued pressure. There is much exudation of lymph, and to the touch the section is tough and unyielding.

Under the microscope the horny layers of the epidermis are seen to be in some places thickened and rugose, in others they are hardly more than normal. The connective tissue of the corium has a swollen gelatinous appearance. The subcutaneous tissue is in one part dense and fibrous, in another soft and jelly-like. The lymphatic vessels are much dilated, and contain lymphatic cells in fibrin (Cornil). In one of Sir Joseph Fayrer's cases of elephantiasis scroti, Mr. D'Arcy Power found the outer layers of the epidermis but slightly thickened, the rete malpighii remarkably so. The subcutaneous tissue was very greatly thickened and contained a large amount of unstriped muscular tissue. The blood-vessels were very numerous and of large size, the lymphatic channels fairly numerous, and some of them of considerable diameter. In another case there was a large amount of lymphoid tissue, and in the subcutaneous tissue small highly refracting angular bodies, staining deeply, supposed to be filariæ.

Simple hypertrophy of connective tissue is the result of over-nutrition of the parts, arising from inflammatory or mechanical occlusion of the lymphatics. Some authorities maintain that though there is a local inflammation, the result of lymphatitis, the disease itself is due to some special dyscrasy, which is probably more or less induced by undue exposure to great alternations of temperature in humid and hot climates. Others trace it to exposure, whereby the part is brought into direct contact with some poison which penetrates the skin. Some have attributed it to malaria also, and others again believe that the whole pathology is to be explained by the fact that a minute animal known as the *filaria sanguinis hominis*, blocks the lymphatics and sets up the inflammation. The theory of the relations between the filaria and elephantiasis arabum is both ingenious and interesting. As long ago as 1866 Wucherer, of Brazil, detected the embryos of a special entozoon in the urine of a patient suffering from chyluria. Unaware of this discovery, Lewis, of Calcutta, in 1868, called attention to his own observations of a like kind, and in 1872 announced that he had found filariæ in the blood of a person suffering from elephantiasis arabum, and gave them the name of filaria sanguinis hominis, and claimed to have found in them the cause of the disease. In 1875 Patrick Manson advanced the opinion that the inflammation caused by the presence of the adult filariæ in the blood produced obliteration of the lymphatic trunks—perhaps even of the thoracic duct—and, arresting the lymph-current, consequent hypertrophy. In 1877, a still further step was made. Some eminent authorities, among them Bancroft and Spencer Cobbold, came to the conclusion that there was evidence that elephantiasis arabum was propagated by the mosquito, and, rightly or wrongly, this is now the generally accepted theory, and it certainly seems to harmonise with many of the facts. It was found that the filariæ reposed in some organ of the patient during the day, and appeared in the blood only at night, which is the time when the mosquito feeds. It was further known that, after laying its eggs, this insect makes its way to the water and there dies, and so liberates the filariæ. Bathing in water thus contaminated, the natives expose the legs and genitals to contact with the filariæ, which either effect an entrance through the skin, or are swallowed in drinking the water. According to the most recent opinion, the female filariæ live in the lymphatics, but beyond the glands, lay their eggs which are carried with the lymph to the ganglia, where being too large to pass, they are hatched, and as embryos follow the lymphatics, and so find their way into the blood. Facts, however, seem to show that elephantiasis arabum may exist without the presence of filariæ, and *vice versâ*, so that we can hardly feel full confidence in the theory without some more satisfactory evidence. *See* FILARIA SANGUINIS HOMINIS.

Treatment.—1. Inflammatory stage.—Rest in bed, with the part raised, if it be the leg or scrotum. Salines and aperients at first, to be followed with quinine or arsenic in full doses, to mitigate the severity of the fever, and opium to relieve pain. Poultices, either hot or cold, should be applied locally.

2. Of resulting enlargement and constitutional condition.

a. Local. — Some authorities advise blistering the enlarged inguinal glands, rubbing iodine ointment into the swollen leg and bandaging it evenly and firmly, while using constitutional treatment. Blistering is said to be of particular value directly the inflammation has subsided. Others prescribe cataplasms and tepid baths or oils to soften and remove the epidermis and crusts, followed by inunctions of mercurial ointment and careful bandaging, to be repeated when the bandage gets loose. The limb to be kept horizontal.

Elastic Bandage.—The use of Martin's elastic bandage has been followed by the greatest success in the prevention of the hypertrophy. It should be applied firmly from the foot upwards immediately after the inflammatory symptoms have subsided, and should be worn for months.

Electricity. — Though not infallible, there is little doubt that electricity is one of the best forms of treatment at present known. A galvanic current of 40 to 60 Trouvé elements, applied from five to thirty minutes, with the *positive* pole on or near the sound part, and *negative* pole on different parts of the affected regions, has been tried with success. Either or both forms of electricity may be used at the same sitting.

Compression of the Main Artery.—The results obtained from digital compression have been satisfactory.

Ligature of the Main Artery.—The best authorities disapprove of this mode of treatment, which is held to be but temporarily ameliorative. In one case, however, cure was effected by this means in six months.

Amputation of the Leg.—This has occasionally to be resorted to, in consequence of the enormous size.

Removal of the Scrotal Tumour.—The spermatic cord, testicles, and penis are dissected out, and no attempt should be made to preserve flaps of integument either for penis or testicles, as it is found unnecessary and seems to be followed by recurrence. Healing is effected in from two to four months. At times removal of the whole tumour, testicles and penis included, has to be performed, but when possible the genitals are preserved, not only to avoid mutilation, but also from fear of sudden and extensive hæmorrhage, and contraction of the urethra. By careful bandaging the operation may be made almost bloodless. *See* SCROTAL ELEPHANTIASIS.

b. Constitutional Treatment.—Quinine and arsenic, or quinine and iron, or iodide of potassium, give the best results, but drugs have but little power either to prevent recurrence of the disease or to check its progress. Change of climate is the most potent remedy, often arresting an attack in its early stages. Europeans should return to Europe and natives remove to a drier district.

MALCOLM MORRIS.

ELEPHANTIASIS GRÆCORUM.—*Synon.* Leprosy, Lepra.—*Definition.*—An endemic, chronic, constitutional disease, analogous to syphilis, varying in its morbid manifestations, according to whether the brunt of the disease falls on the skin, nerves, or other tissues.

Etiology.—This must be considered as regards its production and propagation. Concerning production, neither climate, soil, race, malaria, diet, bad hygiene, nor antecedent diseases, such as syphilis, yaws, or ague, can be regarded as anything more than predisposing influences which favour its onset and development, mainly by lowering general vitality and, therefore, resistance to disease. As regards climate, while it is certainly most prevalent in tropical and sub-tropical countries, it frequently occurs also in cold climates, such as Norway, Iceland, and New Brunswick; in short, it may be found from the poles to the equator, from the east to the west. As for soil, it may occur in high or marshy lands, in town or country, by rivers and seas; and though it is true, in the main, that the home of leprosy is in the vicinity of water, even this must not be said without reservation. Climate seems, however, to have an influence on the form of the disease, as tuberculated leprosy is most common in Europe, probably from the influence of cold checking the action of the skin, and non-tuberculated in warmer climates. Eating fish, especially if putrid, is supported by some high authorities as the cause of leprosy, the idea having, probably, arisen from fish being a staple article of diet in tropical and subtropical countries where leprosy is endemic; but since in many countries leprosy is rife where (either from religious prejudices or other circumstances) no fish is eaten, this theory must be regarded as untenable.

Propagation.—Intermarriage plays a certain part, and in some places, such as the Cape, Provence, Asturia, and Galicia, leprosy is limited to certain families who intermarry.

Heredity has an undoubted influence, and Norwegian authorities consider that it may be transmitted collaterally as well as directly, and that it may even skip a generation, the second and fourth being worse than the first and third. The mixed form is the kind most frequently transmitted, and often only one member of a family is attacked; the disease may, however, be latent many years, until developed by some depressing influence, and congenital cases are very rare; for these reasons many think that, like phthisis, only the predisposition is transmitted. The question whether leprosy is contagious or not, is answered, by the College of Physicians' Report, in the negative; but there is much evidence in favour of its being inoculable even by vaccination, while coitus, prolonged contact, and even breathing the same atmosphere for a long period, seem to have produced it in some instances. The invariable presence of bacilli in the tissues of the tuberculated form, and the fact that the prevalence of leprosy in Norway has been diminished fifty per cent. in twenty years by strict segregation, are circumstances which are also in favour of the contagious theory.

VARIETIES.—The disease presents itself under three aspects: the tuberculated, the non-tuberculated, and the mixed tuberculated lepra. Tuberculated lepra is the most common in Europe, non-tuberculated in the tropics, and mixed tuberculated is always less common than either of the others. Although one pathologically, they are clinically so distinct as to require separate description.

Tuberculated Lepra.—Five stages may be recognised: (1) deposit with prodromata and fever, (2) eruption, (3) tuberculation, (4) anæsthesia (not always), (5) ulceration.

The prodromata which are nearly always present are: debility, depression, dyspepsia, diarrhœa, and drowsiness, a frequent sense of chilliness, profuse perspirations, with marked greasiness of skin, especially in the dark races; frequent vertigo, and recurrent epistaxis which temporarily relieves the vertigo. After a variable time, and, in some cases, without the prodromata, the febrile symptoms set in with a rigor and a rise of temperature, sometimes reaching 104° F., the pyrexia is nearly always of a remittent type, and with the sweatings, simulates ague; but the drowsiness is now very marked, and is very significant in a leprous district; the tongue is red, the pupils sluggish, and the pulse quick and feeble. Then, after a variable period, the exanthem, or 'leprous spots,' appears, coming first with œdema of the eyelids, on the prominent parts of the face, and then on the limbs; it is erythematous in appearance, but attended with deposit from the beginning; it is slightly raised, defined at the edge, from one to several inches in diameter, and distinctly hyperæsthetic at first; in colour it is purplish or mahogany red in fair people, but of a brighter red and shining in the dark races. The spots may come and go for weeks and months, each time with febrile symptoms, and then tuberculation sets in, as a rule, six months from the onset of the disease.

The tubercles come out in crops in the same places as the erythematous eruption, which by this time has faded; they vary from a pea up to a hen's egg in size, and may coalesce into an infiltration, diffuse or in clear-centred circles, or the infiltration may arise directly from the erythema which gradually thickens into this condition, without the intervention of the tubercles. The colour of the infiltration and of the tubercles is from a yellowish to a dark brown in fair, and blacker than the black skin in the dark races. As the tubercles and infiltrations develope, the hyperæsthesia gives way to diminished sensibility or even anæsthesia, which, in this form, is limited to the sites of the eruption, and is due to the pressure of the leprous infiltration on the ends of the nerves.

While tubercles may come anywhere except on the scalp and glans penis, the face, limbs, breasts, scrotum, and penis being the usual sites, the mucous membranes do not escape, and, when tubercles involve the air-passages, they often endanger life.

Ultimately, the tubercles either resolve, leaving stains, or atrophy, leaving scars, or they may break down and form indolent, sharply-defined, red glazed ulcers, with yellow, glairy discharge of a peculiar odour. At first, these ulcers can be healed by appropriate treatment, but as the disease advances they extend, and may involve almost the whole body. When the disease is fully developed, the face gets the characteristic leonine appearance, from the thickening of the skin over the brows between the natural wrinkles, the cheeks look full and pendulous, the lips are swollen and everted, and, with the nose and chin, are covered with tubercles; the ears project, and, even at an early stage, are often much thickened and covered with tubercles, and the lobe is specially enlarged, soft and pendulous. The hair of the scalp is preserved, but is lost elsewhere, and the nails also go or are represented by horny pegs. In the male the testes atrophy and the breasts enlarge; women become sterile, the voice is reduced to a croak, from the tubercles in the larynx, they snuffle from the thickened nasal mucous membrane, and blindness may ensue, from corneal tubercles or keratitis.

At varying intervals—often at the change of the seasons—exacerbations, with fever, occur, with enlargement of the lymphatic glands—especially the femoral—and after each one fresh tubercles appear, and so each attack is a milestone on the downward course.

Ulceration eventually sets in, slowly as a rule, but sometimes phagedænic, and from its extent exhausts the patient, or he may die from interference with the air-passages, extensive internal deposits, or from renal and lung complications, and less frequently from diarrhœa, anæmia, &c. In hereditary cases, before the disease developes, it may be noticed that ordinary sores are indolent and unhealthy, the lymphatic glands are enlarged, the aspect is cachectic, the features coarse and the head large, and the patient is deficient in vigour, both mental and bodily.

The special symptoms in such cases generally come out between the ages of ten and twenty, rarely under three years, and only one or two instances of its being congenital are known.

Non-tuberculated Lepra is the most common tropical form, constituting two-thirds of all the cases. Three stages may be recognised: (1) development, (2) spreading, (3) permanency.

The first lasts one or two years, and includes the prodromata, the eruption and the commencement of atrophy; there are no febrile symptoms with the prodromata, but frequent chilliness is experienced, with malaise and other ill-defined symptoms, but the most characteristic are pain and tenderness in various places, general hyperæsthesia of the skin, and shooting pains down certain nerves, especially the ulnar, the median, and peroneal, accompanied by a burning sensation and tenderness along the course of the nerves; frequently an eruption of small bullæ occurs on the extremities where the nerves are affected, and sometimes 'glossy skin' is developed. Weakness of grasp and numbness in the course of the nerves are early symptoms, and the ulnar is generally the first to suffer.

Within a year the more special eruption breaks out, the most frequent positions for it being the back, shoulders, back of the arms, thighs, round the knees, the elbows, on the face, and sometimes in the course of nerves, especially the musculo-spiral. The spots or patches come out singly as a rule, are one or two inches in diameter, well-defined but not raised, of a pale yellow in fair, but bright yellow in dark races; they may itch or burn, but are not hyperæsthetic and rarely anæsthetic at this stage, but the sweat secretion is absent in them. From time to time fresh patches come out, but unattended by special symptoms; sometimes some of the muscles waste, and there is contraction of the little finger, while sensation in the course of the affected nerve is gone by this time, if it has not before, and the second stage supervenes.

This stage is marked by the spreading of all the patches, except those on the neck, at their periphery, forming irregular circles, ovals, or gyrate figures; the border is now distinctly raised, a quarter or half an inch broad, of a yellowish-brown colour, highly sensitive at the spreading edge, which may be papular or vesicular, the centre is atrophic, preternaturally white, or yellow in dark people, thin, wrinkled, hairless, scar-like, and dry, often covered with a powdery desquamation, and always more or less anæsthetic. The anæsthesia in the course of certain nerves also is always slowly extending its area, and the patient frequently suffers from burns and other unconscious injuries in consequence, while perforating ulcer of the foot is very apt to occur in those who walk barefoot. In cold weather solitary large bullæ very often come on the anæsthetic extremities, leaving an indolent ulcer. Paralysis is usually a late symptom, and is accompanied by wasting of muscles and flexion of the fingers, giving a claw-like aspect to the hand, which drops helplessly at the wrist. Next, interstitial absorption of the phalanges ensues, leaving the nail still attached to the stump, or a larger necrosis may occur; but on the whole, with the exception of sleeplessness, the general health continues good, and often improves when the third or permanent stage is reached, which is in about ten years from the commencement. From henceforth the eruption remains stationary, though by this time nearly the whole body-surface may have been traversed by it, so that the whole skin is atrophied, and white or yellow according to the race. Other nerves, such as the third and seventh, or some nerve of the leg may get paralysed; ulcerations are common, and, though less extensive, are deeper than in tuberculated cases; moist or dry gangrene often occurs, and, spreading until it reaches a joint, a line of demarcation is produced, and a natural amputation is performed. Although the same process is often repeated, it is slow and not extensive each time; the strength is, on the whole, wonderfully preserved, and, unlike the other form, sexual power is retained up to a late period.

Ultimately, however, the ulceration, gangrene, marasmus, and general debility from the leprous poison produce the inevitably fatal result, about two-fifths of the cases thus dying directly from leprosy; muco-enteritis is the immediate cause of death in nearly as many more, and the rest reach their end through various complications, but nephritis is not especially frequent, as in tuberculated lepra.

Mixed tuberculated lepra is the least common form, constituting about one-sixth of all cases, about half are hereditary, and often each parent has had a different form.

It begins sometimes with tuberculated and sometimes with non-tuberculated symptoms, but most frequently the non-tuberculated symptoms take the lead for a few months, and then with fever and the usual phenomena tuberculation occurs. Destruction of the cartilages of the nose sometimes ensues, and the soft palate may also be destroyed by ulceration, and these incidents constitute special features of this form. For the rest the symptoms are a compound of the other two varieties.

The prognosis is bad, and if the tuberculated precedes the non-tuberculated form the progress is more rapid. The diagnosis requires care sometimes, to distinguish leprosy from syphilis, but the presence of anæsthesia would be a certain criterion.

Pathology.—Modern research is strongly in favour of the disease being one of constitutional origin, closely analogous to syphilis, in which special bacilli, either directly or indirectly, by their presence set up inflammatory changes in the tissues, to which many of the lesions are due; they also specially modify by their presence the exudation cells, and the endothelium of the lymphatic and blood vessels forming the so-called 'lepra cells' and giant cells, which impart specific characters to new growths which would otherwise not differ from ordinary granulation tissue, except that the infiltration is in foci instead of being diffused, and is poorly supplied with vessels.

Morbid Anatomy.—The essential features are infiltration of the skin or mucous membranes by foci of small round cells, which are especially abundant round the vessels, and where these are most numerous, viz. round the follicles and glands; interspersed in this infiltration are larger cells called 'lepra cells,' of which there are all gradations, from those little larger than a leucocyte up to the multi-nucleated giant cells. It is in these lepra cells that the bacilli are placed, and the large cells are most abundant in the deeper and peripheral part of a tubercle; there is every reason to believe that the lepra cells grow from the leucocytes or connective-tissue cells under the irritative or stimulating influence of the bacilli, one or more of which may often be seen in a leucocyte-like cell, and many in the lepra cells. The giant cells appear to be derived from the endothelium of the blood-vessels or lymphatics, and also contain bacilli in abundance.

These bacilli can best be brought into view by staining the section or fluid containing them by the Weigert-Ehrlich process for tubercle bacilli; but they require a higher power, a tenth or twelfth immersion, to see them satisfactorily, as they are much smaller than tubercle bacilli. For clinical purposes the fluid from the débris of a broken-down tubercle, or the serum obtained by squeezing a tubercle in a clamp, as Manson recommends, and then pricking the blanched tubercle, should be dried on a cover-glass and stained by the above-mentioned process; the bacilli then appear as red, straight rods, not larger than half or three-quarters of the diameter of a red corpuscle, contrasting with the blue ground. That they are really morbific agents is evidenced by their invariable presence in every case of tuberculated lepra examined, no matter whence it may have come; by their presence coinciding with the development of the lepra cells; and, though inoculation has failed to produce the general disease, a localized leprosy has been produced in dogs.

In non-tuberculated lepra foci of cells are infiltrated between the fibres of the nerve, penetrating from without inwards, until ultimately most of the nerve-fibres become pressed upon individually as well as collectively, but inasmuch as the infiltration is in foci some fibres escape, and this accounts for the oases of sensibility in anæsthetic areas. Bacilli have not hitherto been demonstrated in this form of lepra. Besides these lesions in the skin, mucous membranes, and nerves, tubercles may be found in the pleuræ, but no specific leprous changes have been found in the lungs, liver, spleen, or kidneys, nor even in the enlarged lymphatic glands which are mainly fibroid. The testes, like the sebaceous and sweat glands, atrophy by pressure of the small cell infiltration between the tubules or acini of the glands. Although there is nothing specific in the lardaceous infiltration of the liver, spleen, and kidneys, it is a frequent sequel to the prolonged ulceration, and fatty kidneys are also rather common in the tuberculated cases.

Prognosis.—Almost invariably bad; but existence, though too often in a very miserable state, may be prolonged for many years. The form of the disease exercises a most important influence, the tuberculated averaging seven or eight years, the mixed ten, and the non-tuberculated fifteen years. In all cases heredity, youth, and mental depression have a bad influence on the course of the disease.

In tuberculated cases, unfavourable elements are frequent febrile exacerbations, the extensive implication of the air-passages or internal organs, and the supervention of lardaceous disease from prolonged suppuration; whilst, if the patient comes early under treatment, if the exacerbations occur only at long intervals, if the infiltration is diffuse rather than tubercular, and his general surroundings are good, considerable amelioration of his condition and arrest of the disease for some time may be hoped for. In non-tuberculated lepra the extent of the nerve-implication is a good guide; arrest of the progress of the disease may be produced when this is limited, if there are no serious complications and the patient is seen at an early stage.

In mixed lepra the accidents of both occur, but it is usually intermediate to the other two in duration.

Treatment.—This, unfortunately, can only be palliative or preventive, the number of so-called specifics bearing testimony to the incurability of the disease. Of the many recommended, only two have stood the test of long experience—namely, Chaulmoogra oil, from Gynocardia odorata, and Gurjun oil, from Dipterocarpus lævis. These oils are taken internally, and rubbed in externally. Both are very nauseous, and are best given in emulsion or pearls, beginning with small doses. The Chaulmoogra oil should be begun in doses of three minims, or one pearl, three times a day, after meals, and gradually increased up to the limit of the patient's endurance. Seldom more than a drachm a day can be tolerated, nausea, vomiting, and diarrhœa ensuing if the dose is too great for the individual. Gynocardic acid, in pills, has also been recommended, in doses beginning at half a grain and gradually increasing it up to three grains three times a day. The oil also should be well rubbed in, in the form of an ointment consisting of equal parts of the oil and lard; the friction should be thorough and prolonged, where possible for two hours twice a day, rubbing off the old oil with fuller's earth, or a warm bath may be given.

When Gurjun oil is employed—and it is spoken of most highly by practitioners in the tropics—it is given internally in an emulsion consisting of lime-water three parts and Gurjun oil one part, half an ounce being given twice a day; at the same time a liniment of equal parts of the oil and lime-water is rubbed in, in the same way as the Chaulmoogra oil. The writer finds that in this climate the emulsion cannot be made by this formula, the oil being too solid. For the mixture it is found best to rub it up with powdered gum arabic and water, but English patients could not get to more than a drachm a day, and that only by raising it very gradually from a five-minim dose. The liniment can be made with olive oil instead of lime-water; in the writer's hands the Chaulmoogra oil appeared to be more useful than Gurjun, but in the tropics Gurjun is most valued. Simple oils are also useful for a liniment, and greasy applications always seem grateful to the leper. Besides direct medication, frequent baths are to be used, and strict attention to general hygiene should be paid. Sulphur baths are strongly recommended by some, and since scabies is a very common complication it has a double advantage. The patient should be well and suitably clad, according to the climate, and chills carefully avoided, as they frequently seem to determine a fresh exacerbation.

When the febrile exacerbation is present, full doses of quinine should be given, such as gr. v. of the hydrochlorate every four hours; the strength should be carefully supported by highly nourishing diet, and hot baths are here specially useful; cod-liver oil, after the febrile symptoms have subsided, is beneficial. It is an exploded error that there is any disadvantage in healing the sores as soon as possible, and they should be treated on general antiseptic principles, iodoform and wet boracic acid lint, e.g., are good applications, but when ulceration is very extensive, finely carded oakum over a simple dressing is cheap and efficient, and prevents the fœtor which too often poisons the air of asylums. Most authorities recommend a change to a temperate climate, and certainly patients should be removed from districts where the disease is endemic. There can be but little doubt, however, that cold and variable climates have an unfavourable influence by increasing the liability to chills. In some cases of non-tuberculated lepra, stretching the affected nerve has been beneficial, the anæsthesia and paralysis having been relieved by it. As preventive measures, strict segregation is the only effective plan, and it is probable that the disease was stamped out of England and the greater part of Europe by this means, and the same result will probably be attained eventually in Norway by this procedure.

Those who have to dress the sores of lepers should be very careful if they have scratches or abrasions, and not neglect carbolic acid ablutions afterwards.

H. Radcliffe Crocker.

ELLIS'S SPLINT, for fracture of the clavicle, consists of a well-padded crutch for the axilla, which is supported in position by straps passed from its lower extremity over the opposite shoulder; the arm is held to the side by a transverse strap, and the forearm is supported in a sling.

Bilton Pollard.

EMBOLISM.—The plugging of a vessel by clot or foreign substance set free from some distant part of the circulation.

The process is to be regarded as one of the most important in pathology, not only on account of its direct effects, but from the *rôle* it plays in the occurrence of metastatic or secondary deposits in septic and malignant diseases. It differs from thrombosis in occurring mainly in internal organs and in the arterial system. Venous embolism is met with almost solely in the portal circulation.

Origin and Nature of Emboli.—1. Venous thrombosis is by far the most common source, parietal clots being the most dangerous. Such emboli are usually made up of laminated clot, a careful examination of which will often allow their primary origin to be determined. In some cases they may be found to correspond exactly with the broken end of a coexistent thrombus. Venous emboli commonly originate from the femoral, iliac, pelvic, renal, or jugular veins.

2. Arterial thrombosis.

3. Vegetations detached from the cardiac valves, or portions of clot broken off from coagula formed in the auricular appendages or the spaces between the muscular trabeculæ.

4. Vegetations detached from the surface of the large arteries in advanced atheromatous disease, or portions of clot set free from the interior of an aneurism.

5. Blood-clot developed as a result of intravascular injections in surgical treatment.

6. Portions of new-growth set free in the general circulation.

7. Parasitic cysts, particularly hydatids, developed in the liver, and passing by the inferior vena cava to the lungs.

8. Fat set free by extensive laceration of adipose tissue. *See* FAT-EMBOLISM.

9. Air entering by a cut vein. *See* AIR IN VEINS.

Emboli may be simple, septic, or malignant. Simple emboli only will be treated of here; for further details respecting septic or malignant emboli the articles on PYÆMIA and MALIGNANT DISEASE must be consulted. They may be single or multiple; and primary and secondary emboli are spoken of, the latter taking their origin from the thrombus developed around the primary one. The origin of an embolus, as a general rule, determines its destination. Those from the veins or right heart are commonly arrested in the pulmonary circulation, those from the left heart or arteries in the systemic circulation, and those from the portal system in the liver. Exceptions to these general rules may occur; minute emboli may traverse the pulmonary capillaries, and, gathering clot as they go, become arrested in the systemic circulation; and this is a more probable explanation of hepatic abscess in septic cases, where the origin of the process is in the systemic veins, than the gravitation theory; or larger emboli may, rarely, pass from the pulmonary to the systemic circulation, as a result of congenital deficiency, as a patent foramen ovale. The bifurcation of a vessel, where a sudden decrease of lumen occurs, is the most common point of arrest; this may, however, depend on the shape of the clot: a rounded clot usually lodges in a single vessel, but an elongated one may ride on the bifurcation, only becoming an obstructing embolus when fresh clot has been deposited. Where a large artery breaks up into several branches of about the same calibre (e.g. pulmonary), two or three may be thus, at first partially, then completely, occluded.

RESULTS OF EMBOLISM.—These are twofold in nature: 1. Local, consisting (*a*) in changes in the vessel itself, and (*b*) in the area supplied by it. 2. General, due to disturbance of the general economy from interference with the function of the organ or part supplied. The process is to be regarded as much more serious than thrombosis because of its sudden nature, which, even under the most favourable circumstances, renders anæmia of more or less extended duration inevitable. The results vary according to the size, number, and character of the emboli, also as to the importance to the general economy of the part or organ affected, and to the existence of a competent collateral circulation. Size is of importance chiefly in regard to the calibre of the vessel occluded and the consequent extent of the area affected; number has a similar import; but the character of the embolus is much more serious, as the principal determining point in the changes likely to ensue.

(1) *Local changes* (*a*) *in the vessel itself.* The more or less serious nature of these depends in great measure on the character of the embolus. The first change is secondary thrombosis, extending backwards and forwards to the next collateral branch, or in terminal vascular systems as far as the capillaries. This is followed by an endoarteritis of varying intensity and character. If the clot be of a simple nature the thrombus may organize, and, passing through the usual stages, the vessel either becomes permanently occluded, or its lumen may be more or less perfectly re-established, with a varying amount of thickening of the wall. If the embolus be derived from a clot undergoing regressive change, more extensive inflammation, involving periarteritis, may result; or, if it be septic, an abscess is the constant sequence, without necessarily precedent formation of an infarct. A rough or irritating embolus may, from the local injury or inflammatory softening induced serve as the origin of aneurismal dilatation.

(*b*) *Changes in the area supplied.*—These are threefold in degree: 1. More or less transient anæmia; 2. Infarction; 3.

Necrosis. The most important factors in the determination of the degree of damage seen in the area supplied are the richness of the collateral blood-supply, the strength of the general circulation, and the tendency to degeneration of the special tissue contained. Where the collateral circulation is free, as in the extremities, a temporary anæmia similar to that seen after ligature is in most cases the only result; but this fortunate termination is, as in the case of ligature, dependent on the force of the cardiac action and the capability of the collateral vessels to enlarge; if either of these factors is defective, extensive arterial thrombosis may follow, leading to partial or total gangrene. Certain organs, however, are furnished with a so-called terminal circulation. This arrangement, met with in the spleen, kidney, brain, and lung, is the chief determining influence on infarct formation, the gradual or sudden occurrence of occlusion being rendered irrelevant, as no sufficient collateral channels exist for the re-establishment of the circulation. Congestion and infarction may, however, be hindered or prevented in these cases if the distal veins be provided with valves, in the case of the large veins, by the weight of the column of blood, by distal thrombosis preventing regressive flow, or if the embolus be not completely obstructing. In organs mainly supplied by one artery the blood-pressure in the corresponding main vein is too low to allow a regressive current to develop; and here necrosis may be due to pure anæmia without hæmorrhagic infarction.

Infarcts may be red (hæmorrhagic) or white. The red infarct, met with most commonly in the lung, consists of a wedge-shaped area of dark red congested tissue, within which a considerable escape of blood-elements has taken place by diapedesis. The base of the wedge is at the surface, the apex corresponds to the obstruction. It is developed in the following manner:—The first effect of the occlusion is anæmia of the supplied area; the arrest of blood-supply, with the consequent removal of the *vis-a-tergo* normally exerted on the blood in the veins, is followed by a retrogressive flow of venous blood, the stasis thus induced being succeeded by the escape of blood-elements through the vascular wall, probably rendered more easy by changes in it dependent on its deprival of properly oxygenated blood. In the white infarct met with in the kidney and brain, congestion and hæmorrhage take no part; the colour here depends on local anæmia and the loss of natural transparency due to the condition of coagulation-necrosis induced by want of blood-supply. Further changes take place in either variety of infarct; in vascular tissue, as lung, a considerable amount of reactive inflammation, running on to suppuration, may occur; and in this or other tissues necrosis may follow. In cases of septic embolus necrosis and suppuration are inevitable. In cases of simple infarction, however, the changes, if the lesion has not been so considerable as to cause death, are of a gradual regressive character. The infarct becomes enclosed by a wall of inflammatory new-formation, and the framework of the wedge itself becomes permeated by infiltration of a similar character; where a secreting organ is affected the special cells die and eventually disappear. The process having reached this stage, vascularisation and development of connective tissue usually follow, and this is succeeded by the cicatricial changes noted in other scars. In some cases, however, so high a degree of development not being reached, caseation or fatty degeneration takes place throughout the affected area.

2. The *general effects* of embolism furnish the symptomatology of the process. The symptoms naturally depend entirely on the organ affected; they are primarily those of interference with the natural functions, more or less transient, at times followed by signs of inflammation or necrosis, at others by permanent and complete loss of function. The artery affected determines the gravity of the symptoms in any given case. Thus embolism of the coronary or of one or more of the large pulmonary arteries may lead to sudden death, of the cerebral arteries to more or less permanent and extensive paralysis, of the arteria centralis retina to blindness; while the functions of the lungs, kidneys, liver, and spleen may be more or less interfered with. Embolism of the spermatic artery is of special surgical interest, from the fact of its so commonly being followed by infarction and gangrene of the testis.

Treatment.—No general rules can be laid down for curative treatment, which will depend entirely on the organ affected. In the case of gangrene of the limb following embolism, and consequent arterial thrombosis, time should be given for the restitution of the vascular lumen before amputation is decided on. The more important general point is that of prophylaxis—that is, to observe the greatest caution in disturbing vessels in which clots exist; for instance, to avoid all unnecessary handling in cases of fracture of the thigh or leg in which thrombosis of the deep veins may have followed the injury; to follow the same rule in cases of phlebitis or of aneurism; to be careful that patients do not make active use of muscles after operations for varicose veins or varicocele; and in any case where injections of fluids capable of coagulating the blood are used, to employ compression on the distal side of the circulation.

G. H. Makins.

EMMET'S OPERATION or TRACHELORRHAPHY.—These terms signify the repair of a laceration of the cervix uteri by a plastic procedure similar, in many respects, to those which have long been employed by surgeons for the cure of ruptured perineum and vesico-vaginal fistula. The discomforts produced by these latter conditions are well known, and can be remedied by plastic operations. The advocates of Emmet's operation believe that many severe pelvic symptoms, and many morbid conditions of the uterus, are produced and aggravated by laceration of the cervix; and they further declare that the operation in question effectually remedies the evils which they believe to be caused by an unhealed rent in the cervix uteri. It has been asserted that when the cervix has been torn during labour, subinvolution of the body of the uterus will almost inevitably ensue, with concomitant hypertrophy of the cervix, since the solution of continuity in the cervix seems to interfere with the absorbents, and to arrest the metamorphosis of tissue necessary for a proper involution.

Retroversion is believed by many to be an almost equally constant result of laceration of the cervix, which is said to destroy the symmetry of support given by the attachments of the uterus, the body of which organ being, in such cases, in a condition of subinvolution, becomes topheavy and liable to fall backwards. Dr. Emmet himself holds the theory that the condition once known as ulceration, and now generally held to be abrasion of the os uteri, is really laceration of the cervix, with consequent ectropion of its mucous membrane. The constant friction of the everted tissues sets up much local irritation and discharge, and, if long continued, may cause epithelioma. Here it must be observed that very high authorities have described undoubted cases of cancer of the uterus beginning on a lacerated surface on the cervix, although it is far from true that malignant disease of that part of the uterus arises solely from lacerations. The precise significance of the ectropion described as a result of laceration, as well as the true relation of subinvolution, retroflexion, and uterine discharges to that lesion, have been the subject of much dispute, and the arguments on these questions, and on the advisability of Emmet's operation, will be found in current British and American text-books on diseases of women, and in the recent reports of obstetrical societies.

Some of the advocates of Emmet's operation recommend, as in the assumed homologous cases of ruptured perineum, that if laceration of the cervix be diagnosed after labour, it should at once be washed, and its edges carefully united by wire sutures. This proceeding is said to check hæmorrhage, to lessen the chances of puerperal fever through absorption of discharges by the raw surfaces of an ununited laceration, and to save the patient from much unnecessary trouble, as she may thus recover from parturition and trachelorrhaphy at the same time.

It is when a laceration of the cervix not only exists, but is associated with ectropion of the mucous membrane, and other signs of local uterine disease, that Emmet's operation is considered advisable and justifiable by its advocates in this country. The patient should wear a Hodge's pessary for a short time before operation, and a hot-water injection should be administered every morning and evening. For the operation, it is advisable that the patient should lie almost on her left side, but with her face and abdomen turned somewhat downwards; the knees are then drawn up, the right rather higher than the left. A Sims' speculum is then introduced, so as to elevate the posterior wall of the vagina, the anterior wall falling forward by gravitation, owing to the position of the patient; a Sims' depressor will aid in pushing the anterior wall still further forwards. The attitude in which the patient is placed is known as 'Sims' position.' Many operators, however, prefer the more familiar lithotomy position. The lacerated flaps are then seized by tenacula, and, holding one of these instruments in the left hand, the operator makes a perfect raw surface on one flap, cutting up to the angle made by the divergence of the flaps. The opposite flap is then treated in the same manner. Hæmorrhage must be checked by pressure, and the flaps approximated. The sutures are then introduced, from above downwards, by a special needle, which should be entered at some distance from the margin of one flap and brought out through the opposite flap; it bears a loop of silk, by means of which a silver wire is drawn backwards along the back of the needle. The sutures are lastly twisted, one by one, beginning from above, and bent downwards before the ends are cut short. When the laceration extends to both sides of the os, the flaps must be vivified on both those sides, care being taken to leave untouched a strip of tissue running along the middle of each flap, from the free edge up to the opening of the cervical canal, so as to form an os externum.

When there is much hypertrophy of the tissues of the lacerated surface, the overgrown cicatricial tissue must be freely cut away, so that the denuded flaps may be readily approximated. In the case of multiple or stellate lacerations, the mucous membrane may be cut away in such a manner as to form one raw surface on each side of the os, as in the case when a bilateral laceration is vivified, the precautions with regard to the os being remembered.

After the operation the vagina must be cleansed daily by antiseptic injections, the bowels kept open, and the sutures removed at the end of a week, beginning with the uppermost; the lower may be left in for a week longer if necessary. In a successful case, the cervix will appear, after the patient's recovery, like that of a virgin, or nulliparous woman. Statistics are as yet wanting to prove whether the repair of the cervix be, as a rule, permanent or only temporary, not resisting subsequent natural labours. Alban Doran.

EMMETROPIA. — The condition of normal vision, when the eye is fully capable of being readily focussed for both near and distant objects.

EMPHYSEMA.—In surgical writings, by 'emphysema' we understand the extravasation of air into the areolar tissues of the body. It must not be confounded with the medical term 'emphysema of the lung,' which is a dilatation or rupture of the normally existing air-vesicles of the lung, whereby they become greatly increased in size. Surgical emphysema may be recognised by the swelling of the affected part, and by the crackling sensation communicated to the fingers on placing the hand upon it and making gentle pressure in different directions. It is mostly produced by a wound of the lung, bronchus, or trachea; but is occasionally found in non-penetrating wounds of the thorax.

Emphysema is occasionally, but rarely, seen in wounds of parts other than the chest. Thus in the limbs, in wounds of a crushing or lacerating character, air is sometimes forced into the tissue at the time of the accident. The feeble vitality of the crushed tissue, together with the extravasation of air, makes these cases of more gravity than the nature of the wound would indicate; but if vital parts be not injured, they mostly do well in the end. Such emphysema must be distinguished from the emphysema of decomposition, which is occasionally seen in similar cases, as a preliminary to acute gangrene taking place in the part. In such cases the prognosis is exceedingly grave. The one condition may pass into the other if the injury be severe, and thus the recognition of the state may at first be rendered difficult. But the swollen, dark red appearance of the part affected with the emphysema of decomposition, together with the speedy formation of livid patches upon the surface, will dispel any doubt that may be entertained. Very free incision into the part so affected is the very least that can save the patient, and if it be a limb in which the condition occurs, the expediency of immediate amputation will have to be considered.

Emphysema also occasionally occurs from wounds or fistulæ in connection with the alimentary canal. Thus the writer has seen it occurring very extensively about the buttock in a case of ordinary anal abscess. In such a case there is usually an ulcer through the wall of the rectum, and the peristaltic movement of the intestine forces some of the intestinal flatus through this aperture into the areolar tissue of the ischio-rectal fossa, from which it spreads to the surrounding integuments.

But by far the most frequent cause of emphysema is fracture of one or more ribs, by which the lung has been wounded. It is occasionally complicated with pneumo-thorax—i.e. air in the pleural cavity—and sometimes even with hæmothorax. In such cases, in the movement of inspiration, air gets sucked into the pleura, and in the succeeding act of expiration is squeezed into the subcutaneous cellular tissue. Emphysema produced by such a cause is of moderate extent, and generally absorbs rapidly and completely. But emphysema often occurs without the complication of pneumo-thorax. This most frequently takes place in young people, especially when the wound of the chest is small, and has a valvular character. It is produced by the wounded surface of the lung becoming opposed to the wound in the pleura, so that, in the movement of expiration, the air is squeezed directly out through the pleural wound under the integuments. Where the lung is fairly healthy the tendency to retraction is but small. Thus, even in an extensive incised wound of the thorax, where the lung has been exposed, pneumothorax is not necessarily produced. In such cases the lung has been seen moving, in each act of respiration, against the thoracic parietes, and the pleural cavity remaining free of air. The cases of hernia of the lung are also illustrations of the same fact.

Sometimes the emphysematous condition of the tissues is not found at the seat of injury, but at the root of the neck. This is generally considered as a sign that the root of the lung has been injured, and that the air has extravasated into the posterior mediastinum, and has thence travelled upwards into the root of the neck. Although this may be a correct interpretation of the facts in some cases, it does not appear to be so in all. In some cases emphysema at the root of the neck appears to be due to rupture of the air-vesicles at the upper part of the lung, directly under the dome of the pleura, this being the direction of least resistance when any violent expulsive effort is made upon the chest-cavity. When adhesion exists in the pleural cavity, as is frequently the case, the direct passage of the air from the injured lung to the surrounding areolar tissue is rendered easy, without the possibility of the formation of any pneumothorax. But without this aid, in severe compression the force will often be sufficient to rupture both lung and dome of pleura, and thus extravasate air into the root of the neck.

Emphysema may vary most immensely in amount, from those slight cases in which only a little crepitation is felt under the skin, to those extreme ones where the whole body is blown up like a sausage, threatening death every instant from the difficulty of respiration, and from impeded action of the heart.

Treatment.—In the great majority of cases the emphysema is best left alone. The most extensive extravasations will absorb and get well of themselves, if left quietly to nature. Only in those cases in which death is impending from suffocation, or impeded action of the heart, is surgical interference called for. In such cases, however, it should be prompt; it may be sufficient in some cases to puncture the skin in many points with a fine trocar and canula, and thus allow the air to escape; but in others this will not be quick enough in the relief afforded, and in these it is better to make several small incisions through the skin in different parts of the body, so as to allow of the rapid exit of the air. The relief thus afforded is very great; the swelling rapidly subsides, and the patient returns to his normal appearance.

The *prognosis* in all these cases is very favourable. Even in the very severe forms above described, where surgical treatment is necessary, the incisions heal, and the patient gets well very rapidly.

H. G. Howse.

EMPROSTHOTONOS. *See* Tetanus.

EMPYEMA.—The word 'empyema,' though it has sometimes been more loosely employed, should only be used to describe a collection of pus in the pleural cavity.

It is essential for the surgeon to appreciate the various causes which may give rise to this condition, because his treatment to some extent, and his prognosis very largely, will depend upon this consideration; but it would be beyond the scope of a surgical work to give more than a brief enumeration of these causes.

Causes.—1. *Traumatic.*—Two kinds of injury may be followed by empyema—a penetrating wound of the chest, with or without injury to the lung, and a contusion of the chest-wall, with or without fracture of rib or injury to lung. The former includes gunshot wounds, thus possibly involving the presence of a foreign body in the pleura, and results most likely in a septic empyema; it may be accompanied by the presence of gas in the pleura—pyo-pneumothorax, due either to the entrance of air from without through the external wound, or from within, owing to a wound of the lung, or to the presence of the gaseous products of putrefaction. The latter arises in some not easily explained manner, and is a rare sequence of such injuries; it is probably, in most cases, the consequence of a serous effusion or hæmorrhage resulting directly from the injury, and may, if the lung is injured, be a pyo-pneumothorax.

2. Empyema may be the outcome of a simple serous effusion, occurring, perhaps, as a result of exposure to cold or wet, or during or after any of the acute fevers, or in the subjects of the rheumatic, and, still more, the tubercular diathesis; but it seldom or never follows the dropsical effusions which accompany some diseases of the heart and kidneys. Under this heading, perhaps, should be included the purulent effusions that occur in the

course of attacks of septicæmia, which are often bilateral.

3. It may be caused by an extension of inflammatory mischief from the lung; this may be of several kinds—e.g. the pleurisy accompanying acute pneumonia, or that which forms around the embolic abscesses of pyæmia; or the rupture of a gangrenous patch in a pneumonic lung, or that of a tubercular vomica, or, again, it may be the result of the presence of a foreign body which has been inspired into a bronchus.

4. An empyema may be the consequence of rupture into the pleura of morbid materials from other situations; such, for instance, as a hydatid of the liver, a hepatic or a pericæcal abscess, or an abscess connected with disease of the ribs or sternum, the cervical or dorsal vertebræ, or a mediastinal gland; or it may result from the burrowing downwards of pus after cut-throat or tracheotomy, or after injury or disease of the œsophagus, or of other structures in the neck.

Varieties.—An empyema may be universal or localised—that is, the collection of pus may be free in the pleural cavity, or it may be circumscribed by adhesions between the visceral and parietal layers of the pleura. In the latter case there may be more than one collection on the same side of the body, e.g. one between the base of the lung and the diaphragm, and one in another part of the chest. The signs will thus vary in different cases; but the typical ones, all or some of which may be present, are (*a*) a general distension of the affected side, with bulging of the intercostal spaces, so that the outline of the chest on the affected side becomes more circular than normal; (*b*) more or less immobility of that side; (*c*) dulness on percussion over the position of the fluid. This dulness is fixed in a localised empyema, but if it be not localised will vary with the position of the patient unless the collection of fluid is very large, in which case the chest will be completely dull both in front and behind. (*d*) Absence of breath-sound, vocal fremitus, and resonance over the fluid. The first of these is a very untrustworthy sign, especially in children, bronchial breathing being often heard over the whole of the dull area. It is important to notice that the breath-sound on the affected side is almost always decidedly weaker than on the sound side. (*e*) Displacement of the viscera—i.e. of the heart away from the affected side, and of the liver or spleen downwards. (*f*) More or less dyspnœa, generally relieved by placing the patient on the affected side. (*g*) A varying amount of fever, the evening temperature being usually much higher than that of the morning, but the total amount of elevation being very inconstant. (*h*) If gas be present in the pleural cavity there will be the usual signs of pneumothorax; and (*i*) if there be an opening between the pleura and the lung, there will be more or less purulent expectoration. (*k*) In old cases retraction of the side occurs without any evacuation of the contents, as a result of the absorption of some part of the pus. This retraction is not inconsistent with the presence of a large quantity of pus in the pleural cavity.

Diagnosis.—It will thus be seen that the diagnosis of an empyema from a simple serous effusion or hæmothorax, or from certain pulmonary conditions, is often very difficult. In all cases, but especially in doubtful ones, the surgeon should clench his diagnosis by inserting through an intercostal space the needle of a small exhausting syringe, or—what answers the purpose equally well—a fine exploring trocar. This, if the skin and the instrument have been efficiently purified by an aqueous solution of carbolic acid (1 to 20), can do no harm; but if this precaution be not used, or if reliance be placed on that very untrustworthy material, carbolised oil, a simple serous or sanguineous effusion, or an aseptic empyema, may be converted into a collection of fœtid pus. An advantage claimed for the exhausting syringe over the exploring trocar is that sometimes the withdrawal of a small quantity of fluid has seemed to start the process of absorption, which afterwards has continued until all the pus has disappeared. It is obvious that the presence of pus should be placed beyond doubt before any operation for its evacuation is attempted.

Age at which it occurs.—Empyema may occur at all ages, and is a common disease of children.

Contents.—Empyemata vary very much in the nature of their contents. Sometimes the fluid is thick, often very thick, pus; sometimes it consists of a turbid material mixed with flakes of lymph, and in the instances where serous effusions become in time purulent, it is clear that all the stages between serum and pus must be passed through at one period or another. Again, while the contents of an unopened empyema are mostly free from putrefactive smell, those of one which communicates with the lung or with the exterior of the body, or which has arisen by the burrowing of pus from around the cæcum or other localities, may be septic in the highest degree. It is not improbable that many cases of turbid effusions containing flakes of lymph undergo spontaneous absorption, and it is certain that the same process may occur, and possibly does so, more often than we suspect in cases where the fluid is true pus. Still, the occurrence is not common enough to warrant the surgeon in ever waiting for it to take place. It is not intended by this to state dogmatically that all empyemata should be opened or even aspirated; for it appears that, in some phthisical subjects, such a proceeding actually accelerates the disintegrating process that is going on in the lung. In these cases, however, the collection of fluid is left alone, though not in the hope that it will be ultimately absorbed.

There are, however, other conditions in which delay is recommended: namely, those in which an internal opening for the exit of the pus has been formed; such cases follow sometimes, though not always, a very favourable course. The directions in which a spontaneous rupture may occur are as follows: (*a*) into the lung, in which case the empyema may be expectorated; (*b*) into the stomach or intestine, when it may be passed with the stools; (*c*) behind the deep fascia of the abdomen, when it may burst into the peritoneum, or, as is more likely, may point through the abdominal wall or at the groin, or even at a lower point in the lower extremity; (*d*) the most common position, viz. through the thoracic parietes. The opinions of various observers differ very much as to the commonest seat of spontaneous rupture, some assigning the second or third interspace in front, some the fifth interspace near the junction of the rib and cartilage, and others still farther towards the back. The writer has seen examples of all, but perhaps more high up in front than in any other place.

Treatment.—If spontaneous rupture have not occurred, no time should, in the great majority of cases, be lost in evacuating the fluid, for the longer it is left the more will the lung be disabled by compression, and the less will its expanding power be able to come into play. For this there are two methods—*aspiration* and *free incision*. There are strong arguments both for and against aspiration. In favour of it, it may be said that a certain number of cases, especially in children, are undoubtedly cured by this method, sometimes by a single tapping, but more often after it has been repeated two or three times; and, if it do succeed, the cure is more rapid, an open wound is avoided, and a complete collapse of the lung is possibly prevented. It should be remembered that a cure taking place by this means almost necessarily involves the absorption by the pleura of a certain amount of pus; for it is clear that unless the lung be at the time of aspiration capable of complete expansion—a not very likely condition—it is almost impossible, by the most forcible exhaustion, to empty the chest completely. And, indeed, the operator should not make this his object, but should stop the exhaustion if the patient begins to cough, or if any blood appears in the syringe. If, after aspiration, the fluid steadily reaccumulates, the operation should be repeated after a not longer interval than a week, and if after two or three aspirations a cure does not seem to be taking place, the writer would advise that a free incision should be made without delay. Against aspiration it may fairly be said that in the majority of instances it is unsuccessful, and, if it fail, precious time, as regards the condition of the lung, will have been wasted; and it should be added, that in the cases in which it is most likely to succeed, viz. children, the free incision is a highly satisfactory operation.

Aspiration.—It is not necessary to give the details of aspiration, which will be found under ASPIRATION and ASPIRATOR. The following practical points may, however, be mentioned:—The surgeon, will, of course, be careful to carbolise, not only the skin, but the outside and the inside of the canula. The latter object is best attained by drawing some carbolic acid solution through the syringe. Care must also be taken to avoid wounding the lung with the point of the instrument. At the end of the operation it is not unlikely that the canula may be obstructed by contact with the lung; if this occur, its point should be directed downwards and backwards towards the lower part of the chest. It will be found most convenient to employ the bottle aspirator, and to continue the process of exhaustion as the fluid flows, rather than to make several successive vacuums, so that an excessive negative pressure may not be exerted at any time upon the contents of the pleura. A long canula and trocar, so arranged that a blunt plug can, if necessary, be substituted for the trocar, for the sake of clearing the canula without allowing the entrance of air, is recommended in preference to a perforated needle. Such canulæ, which cannot injure the lung as it expands, are supplied with many of the French aspirators. In some cases it will be found convenient to make a minute puncture in the skin with the scalpel, so that the canula may be introduced without a jerk. The puncture is afterwards to be closed with collodion, or if oozing take place, an antiseptic dressing is to be applied.

Free incision.—If it be decided to make an incision into the chest, all are agreed that the opening should be a free one; but opinions vary very much as to the best way of making this opening.

1. *Position of opening.*—If the matter be already pointing, it is well to evacuate the subcutaneous collection, whether a second opening be made or not. If the surgeon be free to choose the spot, he may select that which in modern text-books is described as the seat of election, viz. the sixth or seventh interspace, just in front of the posterior fold of the axilla; or that recommended by Mr. Marshall, viz. the fifth interspace, just external to the cartilages (following, according to the wide experience of this surgeon, the most common seat of spontaneous rupture); or he may select a point further back, as was done by the older surgeons, viz. the eighth or ninth interspace, slightly external to the line of the angle of the scapula. This is the position which, in the writer's opinion, is—always in children, and usually in adults—the most advantageous. Or, lastly, he may make the opening low down behind, in the tenth or the eleventh interspace. There are obvious objections to the last of these plans. 1st. The lower limit of the pleura behind is liable to considerable variation. 2nd. This part of the cavity is sometimes obliterated by adhesion of the two pleural surfaces, although the upper part of the space is filled with fluid. 3rd. The lower part of the pleura is that which in successful cases is the first to close, and, when this occurs, the efficiency of the drainage-tube and its easy introduction is much interfered with by the upward direction imparted to it by the pressure of the diaphragm. No rules can be laid down for the position of opening a localised empyema.

2. *Method of incision.*—A free opening may be obtained either by making a long incision in an intercostal space, or by making a shorter incision and removing a portion of rib. The former is rather the simpler operation, and is recommended in cases where the intercostal space at the point selected is sufficiently wide, and should, if possible, be adopted if the matter is putrid; the latter has considerable advantages, which will be stated below.

The patient should be placed at the extreme edge of the operating table, and as nearly as possible on his back. If he be rolled on to the sound side, the breathing may be seriously interfered with if he be under the influence of an anæsthetic, and if there be a communication between the pleura and the lung, there is danger of the expectorated pus passing into the bronchi of the healthy side, and setting up serious mischief there. The writer prefers chloroform to ether for the anæsthetic, on account of the occasional inconvenience, or even danger, from the excessive secretion of bronchial mucus which may sometimes result from the latter. The arm should not be raised to more than a right angle with the trunk, as otherwise the skin is inconveniently displaced. By drawing it up to this level the skin will be slightly raised; the operator should notice the extent to which this has happened, and must make his preliminary incision proportionately above the intercostal space; he may, in most cases, divide the structures with one sweep of his knife down to the rib above the space. If this precaution be neglected, the opening will be found to be inconveniently valved when the arm is depressed.

The incision should be two or three inches long, the length depending upon the size of the patient. If, after the deep incision has been made, it is found that it does not quite correspond to that in the skin, the after-treatment will be greatly facilitated by making the latter T-shaped, the vertical cut being made upwards or downwards as the case may require. After the hæmorrhage has been stopped in the superficial parts, the intercostal space is explored with the finger, and the knife is directed to the rib bounding it below, and is carried along its upper border through the intercostal muscles and the pleura. In this way the intercostal vessels which occupy the groove on the under surface of the rib are effectually avoided. If more convenient, the deep incision may be made short in the first place, and afterwards enlarged by expanding the blades of a pair of dressing-forceps inserted into it. The finger is then passed through the intercostal space, to explore the cavity and ascertain that there are no flakes of lymph obstructing the rest of the pus, or other peculiarities of the case requiring attention, and then the matter is allowed to escape freely. It is well, if the operation be performed antiseptically, to place a piece of rag soaked in carbolic solution over the wound during the escape of the pus. If an intercostal artery be wounded, one of two courses may be pursued; either the finger may be pressed upon the wounded vessel, which will arrest the hæmorrhage in the course of a few minutes, or the surgeon may at once proceed to the removal of a portion of the rib behind which the artery is situated, as will be described in the next section, and the artery will be secured without further difficulty.

3. *Removal of rib.*—The operation of removal of a portion of rib is performed in this way. The incision is made as before, but at a somewhat higher level, through all the soft parts, including the periosteum and the rib. The transverse cut is in this case almost essential. The periosteum is then raised from the rib by means of a periosteum-elevator, a very convenient form being that of a short chisel, with a transverse steel handle. A very blunt and slightly curved periosteum-elevator is then slipped between the deep surface of the rib and the periosteum, without rupturing the latter, and when by this means a piece of rib 1½ inches long has been completely denuded, and is pressed forward by the elevator held beneath it, the denuded portion is cut away, either by means of strong bone-pliers alone, as may usually be done in a child, or after first sawing it pretty deeply with a small saw, as is sometimes necessary in the adult. A special forceps for the purpose has been introduced by König, having one blunt and grooved blade for slipping beneath the rib, and the other a sharp blade, which, when the blades are closed, fits into the groove on the deeper one. After the portion of rib has been removed, the periosteum can be divided at leisure, and exactly in the required position, without any fear of wounding the intercostal artery. If the periosteum be very thick, a short vertical cut upwards will free the opening in a most satisfactory manner.

In urging this method of procedure as a uniformly good plan in children when the opening can be made behind, and in all cases where the ribs are close together, the writer simply maintains — 1st. That an opening is obtained sufficiently large to enable all flakes of lymph and solid material to escape, and to allow of the introduction of the finger, with the object of ascertaining the state of the cavity and the possible presence of other localised collections of matter in the immediate vicinity of the incision. 2nd. A drainage-tube of large size can be introduced, and on future occasions it can be removed and reintroduced without discomfort to the patient. The operation is not recommended from any idea that it will favour the falling in of the chest, such a result being quite out of the question. The continuity of the rib is reestablished within a few weeks, and the writer has not, after considerable experience, found any inconvenience from non-union of the rib or excessive formation of callus. The latter condition has, however, in the hands of some surgeons occasionally led to difficulty in the performance of other operations which have been deemed necessary—a difficulty, however, which has been easily overcome.

Drainage-tubes.—Much space would be required to describe all the varieties of tube which have from time to time been devised and recommended. The writer always employs a very simple tube first recommended by the late Dr. Baxter, which anyone can make for himself, and which will be found invariably efficient. The end of a piece of indiarubber tubing, varying from a quarter to half an inch in diameter in accordance with the size of the cavity, is split into four pieces. These four pieces are drawn through a hole rather larger than the tube, cut in a piece of caoutchouc $\frac{1}{10}$ to $\frac{1}{12}$ inch in thickness, and about 1½ inch square; they are then turned down and each of them is fixed to the flat piece by a stitch of silver wire, the ends of the wire being twisted and turned down flat. A flanged tube is thus produced, the flange serving the double purpose of keeping the tube in position and preventing the possibility of an untoward accident that has occasionally happened, viz. the slipping of the tube into the chest. Flat tubes, double tubes, and solid tubes, made of silver or vulcanite or celluloid, have their special advantages in certain cases, and may be devised to suit particular conditions. The length of time for which the tube should be retained depends upon the amount of discharge; when this becomes very small, a tube of smaller calibre may be substituted for the first, but no definite rule with regard to time can be laid down in adults. In a simple, uncomplicated case in a child, it will often be found advantageous to withdraw the tube either at the expiration of, or soon after, the end of the first fortnight; but if, after doing so, the temperature should rise or the discharge increase, the tube should be reintroduced without delay.

Sometimes a second opening seems desirable, either at first or when, after a time, it is found that matter continues to collect at the posterior and lower parts of the pleura. Such a second opening may readily be made by passing a stout and long probe or metal bougie from the first opening to the selected spot, and cutting down upon its end, which is made to project through an intercostal space.

If the temperature remain normal, the patient should not be kept in bed after granulation is fairly established; the change of position, and the greater movement of the chest-walls resulting from the alteration of position favouring the complete evacuation of the contents of the pleura.

The treatment of old cases of empyema, with contracted chest-walls and greatly thickened pleura, often presents almost insurmountable difficulties. If little or no falling in of the chest or expansion of the lung have occurred after the lapse of months, it may be said at once that almost any line of treatment will be unsuccessful; but if the pleura be reduced to a small cavity at the top of a long sinus, much may be done if it be remembered that it is the upper and not the lower part of the pleura which presents the obstacle to healing. In order to close the lower part great advantage may be gained by removing three or four inches of several (four or five) ribs with the subjacent thickened pleura. A flap, including all the soft parts, surrounded by a suitable angular or curved incision, must be turned off the rib, and then each one must be removed separately, following the directions given above for the removal of a single rib; the thickened pleura may then be freely snipped away with scissors, any vessel which is divided in the process being at once secured. But the bleeding, which is often free whilst the ribs are being exposed, in these old cases is generally quite insignificant during the later steps of the operation. The tube must then be placed in the upper part of the incision, and carefully maintained in this position. There will, however, generally be left a space included by the first or the upper two ribs, which cannot, owing to the structure of the parts, contract. The most satisfactory results under these circumstances will be obtained by making an opening at the first or the second interspace—a somewhat formidable and difficult operation. The cavity is thus reduced to a minimum, and is effectually drained by a short straight tube, which the patient himself can change without difficulty.

If an empyema have reached the chronic stage, and no advance is being made, or if the discharge be persistently putrid, great good may be obtained by injecting the pleural cavity with some stimulating or antiseptic material, of which, perhaps, the best is a solution of iodine. But great care must be employed in using this remedy, as many cases have been recorded in which sudden death has occurred during the process. For this reason injection should not be resorted to unless there seems to be a decided need for it. The safest and most satisfactory plan is to use an irrigator, best made from a glass bottle, with a hole admitting a cork in the side near the bottom. Through the cork is passed a rigid tube, communicating by means of an indiarubber tube some feet long, with a piece of gum elastic catheter, not large enough to fit tightly into the sinus. After introducing the catheter into the cavity, the bottle is to be raised very slightly above the level of the bed, and, if the catheter be not too large, the lotion will presently flow to some extent alongside it from the orifice of the sinus, and thus undue pressure will be avoided. But, if the patient begin to complain of a sense of distension, the catheter must be at once withdrawn and the fluid allowed to escape. The solution should be used warm, and if tincture of iodine be employed it should be made of about the colour of sherry. Condy's fluid, boracic acid and other preparations find favour with some surgeons, and in some hands the employment of the last-named drug methodically in the early stages of the treatment appears to have been followed by very satisfactory results.

No description will be given of the methods of dilating old sinuses by means of sponge-tents and other dilators, because such methods are seldom of use; nor will other plans of dividing ribs in these cases, with or without removal of a considerable portion of the centre, be detailed, because the writer has no experience of them, and the exact method of performing the operation will be suggested to the surgeon by the particular case. It is also only necessary to mention the fact that sponge-grafting has been said to have given satisfactory results, when employed with the object of filling up cavities which have proved very obstinate.

Prognosis.—As to prognosis, it may be said that, 1st, *cœteris paribus*, the longer the case has lasted the smaller is the chance of the lung expanding. 2nd. A localised empyema is more favourable than a general one. 3rd. The presence of lateral adhesions between the lung and the chest-wall is a good sign. 4th. The more rigid the chest-walls, the less chance is there of a cure; hence, as well as for other reasons, the prognosis is almost always favourable in a child, and generally unfavourable in those above middle age; hence, also, it is a good sign when the shoulder begins to drop and the chest to fall in. 5th. Tubercular cases are bad. 6th. Stinking cases are less favourable than those which are aseptic; though it must be owned that, especially in children, they often do equally well. 7th. There is a general impression, perhaps unsupported by sufficient evidence, that a right-sided empyema is a more serious affair than one on the left side. 8th. It does not seem that the previous bursting of the empyema into the lung has much influence in the prognosis; nor does rupture into the intestine necessarily prove a serious complication. 9th. Empyema on both sides of the body at the same time is almost necessarily fatal, unless one or the other be localised; except in those cases in which the purulent contents are absorbed. If a general empyema have been opened, and another form on the opposite side, it is obvious that the only surgical treatment for the second collection is by aspiration.

In speaking of prognosis, it must be borne in mind that an unfavourable result does not necessarily imply an immediate or even rapidly fatal issue. The result cannot be said to be favourable if a sinus remain, communicating with a cavity constantly discharging pus, though the patient may live in comparative comfort for many years, and only fall a victim at last to the gradual development of albuminoid changes. The writer has under observation a strong man whose empyema was opened nine years ago; he is now doing a good day's work as a costermonger, and is only recently beginning to show, by his somewhat pallid colour and clubbed fingers, that some of the changes hinted at are probably in progress. This peculiar pallid or earthy appearance may be noticed at much earlier stages of the disease.

Many empyemata, on the other hand, are much more rapidly fatal. Some of the tubercular cases die of rapidly advancing tubercular changes, or more rarely develop an empyema on the opposite side. The latter accident occurs in some of the septic cases, and these are also liable to die from the direct effects of blood-poisoning. A curious complication of septic cases must also be hinted at, viz. cerebral abscess, which, though it is difficult to trace any causal connection between the two conditions, has happened in a sufficient number of instances to make it impossible to overlook the possible association of one with the other.

Not the least common cause of death after empyema, however, is a slow process of exhaustion, in which the patient gradually sinks under the effects of the prolonged suppurative discharge. Two other very serious and not very uncommon complications of empyema are the occurrence of pericarditis and peritonitis.

It is impossible to conclude this article without expressing the belief that, although great advance has been made in recent years, we have not yet arrived at the best possible method of dealing with old chronic cases of empyema.

Rickman J. Godlee.

ENCEPHALITIS, MENINGITIS, and ABSCESS OF BRAIN.—Traumatic inflammation affects either the membranes or the substance of the brain. Meningitis is the term applied to the former, encephalitis to the latter. When it is wished to differentiate inflammations of the dura mater from those of the pia mater, the term 'pachymeningitis' is applied to the former, and 'leptomeningitis' to the latter. All inflammations of the surface of the head, arising either from idiopathic or traumatic causes, may lead to intracranial inflammation; but injuries of the brain itself are most likely to give rise to encephalitis.

Meningitis takes its origin from superficial lesions, such as inflammations of the scalp, injury to the bones and brain-membranes, the inflammation spreading inwards. Perforating injuries of the skull, involving the dura mater, are frequent causes of inflammation of these membranes. Caries of the petrous portion of the temporal is one of the most frequent causes of external pachymeningitis, and it ends, as a rule, in suppuration. It is said that when the dura mater has been detached from the interior of the skull by effusion of blood, inflammation is frequently set up in that membrane. The writer considers that pachymeningitis arising from such a cause must be rare, unless when the dura mater has been subsequently exposed to the unpurified air.

Encephalitis (traumatic) may arise in either of two ways: from injury to the brain-substance, such as contusion and laceration, or it may be secondary to meningitis. Inflammation, beginning in the brain, does not generally extend beyond the pia mater, and any effusion which might take place more superficially would be subarachnoid and not subdural, unless the inflammation were very severe. On the other hand, in pachymeningitis, the inflammation does not generally extend deeper than the arachnoid, the subdural space being more or less distended with turbid fluid. As a rule, the inflammatory action, commencing in the brain, affects the membrane next to it; and inflammation commencing in the scalp or skull affects the dura mater.

Meningitis may arise by the extension of inflammatory processes from the scalp to the interior of the skull. Erysipelas and diffuse inflammation of the scalp are in this way regarded seriously, as they are liable to lead to intracranial mischief. In fatal cases of this kind the upper portions of the hemispheres are found affected; the brain-substance and the pia mater being deeply congested, and this is accompanied by sub-arachnoid effusion of turbid fluid. These may be all the morbid changes that are seen. In chronic cases, such as may originate in caries or necrosis of the bone, the inflammatory processes may have gone no further than the dura mater, which has become thicker and more vascular than normal, and which may be adherent to the bone. Should the osseous inflammation extend, or become more acute, the dura mater may become softened and separated from the bone by plastic exudation or by pus. Molecular disintegration of a portion of the dura mater may ensue or a slough may be formed. It is unusual for the inflammation to extend in the dura mater centrifugally, or much beyond the area of the original injury, such as the affected bone, although it has been known to extend to the base. It is quite otherwise with the arachnoid. Once the arachnoid has become involved, there is rapid spreading of the inflammatory action, frequently involving the whole of the upper aspect of the vault on the affected side, though rarely extending to the base. In such cases the cavity of the arachnoid becomes distended, more or less, with inflammatory effusion, which is generally of a purulent character. The inflammatory action may spread to the pia mater, and when it does so there is almost necessarily an involvement of the cortical substance of the brain, which becomes softened, of a darker colour than normal, and adherent to the pia mater. This membrane becomes much thicker and more vascular, and occasionally the inflammatory action, when chronic, has so altered the appearances of the parts by reduction of the cells to their embryonic condition and by plastic exudation, as to render it difficult to draw the line between the grey matter and the adherent pia mater.

The manner in which the inflammation spreads inwards from without the skull, is stated to be through direct contiguity of structure. It is also supposed to spread along the veins which establish communication between the intra-cranial circulation and that of the scalp. The chief of these are the emissary, which pass through the principal foramina, likewise the facial and those of the diploe.

In encephalitis arising from contusion of the brain the pia mater is much thickened and infiltrated, and any exudation which may take place will be found on the cerebral side of the arachnoid. In this it is like idiopathic encephalitis, the cavity of the arachnoid being free from effusion, unless in most acute forms of inflammation.

The inflammation of the pia mater generally spreads all over the upper and lateral portions of the affected hemispheres. When the encephalitis occurs in the white substance after injury, it generally arises in a portion of the brain which has been contused, and where at least punctiform ecchymoses exist. It is assumed that when encephalitis follows concussion it begins in such an area of punctiform ecchymosis. These patches become the seat of inflammatory new-formation, giving a peculiar saffron colour to the affected part. A general softening of the brain-tissue ensues, which may pass on to the formation of an abscess. Though the affected areas do not extend further, as a rule, than the original seat of injury, still there are occasions when the inflammatory action spreads greatly, the tissue becoming diffluent. When pus is present, it is usually of a yellowish or yellowish-green colour. Occasionally it is brown and fœtid.

Diagnosis.—The symptoms are very variable, no two cases following exactly the same course. One of the most constant, as well as one of the earliest, is cephalalgia, the pain being either diffuse or localised to a particular region of the head, often corresponding to the part struck, though at times situated at the opposite side of the head, when injuries of the brain from *contre-coup* may be suspected. Though the temperature is variable if the whole course of the disease is considered, yet at an early period (the initial stage) there is a pretty constant elevation. The rectal temperature is a much surer test than the axillary or oral, and whenever possible ought to be taken in such cases. The pulse is generally quick in the early stages. The patient loses his appetite, and becomes fretful, sleepless, and hyperæsthetic to external impressions, such as light and sound. At the commencement the pupils are more or less contracted, though they are sensitive to light; occasionally slightly so.

At a later period, occurring immediately after the symptoms just described, or after a variable interval, during which the patient may even seem to improve, another series of symptoms sets in. The patient becomes drowsy, and soon exceedingly so, perhaps answering questions quite correctly, though with a dreamy, hazy aspect, or accompanied by a meaningless smile, and immediately thereafter passing into a profound sleep. The face is pale and earthy; sickness, accompanied by vomiting, is frequent. Twitchings of the muscles or even convulsions are present, which may point to the special part of the brain affected. These convulsions may be followed by paralysis of the affected muscles. Delirium is frequent at this period. The pulse and the temperature often undergo a marked and characteristic change. The pulse, which at the onset of the symptoms was quicker than usual, now becomes slow, often markedly so. In one case under the writer's care—a girl aged fifteen years of age—the pulse was not more than 40 per minute, with an occasional intermission. The temperature is likewise subnormal, 97° F. or even lower. The decrease in the temperature must not be mistaken for a sign of recovery.

These symptoms are generally succeeded by a very short stage, in which (it may be within a few hours) the temperature and pulse go up with a bound, the former to 104° F. or higher, the latter to 130 or more; the face becomes flushed, the pupils dilated, the sphincters relaxed, the patient comatose, and death rapidly ensues.

In some cases localised pain may be discerned on tapping over the seat of injury or disease. This requires to be done in a systematic manner, one part being compared with another. In others, the application of cold and heat, alternately, may reveal a tender spot, which sometimes corresponds to the seat of lesion.

Abscess of the Brain.—In abscess of the brain, the above symptoms may be the only ones present. In other instances there may be, in addition, vomiting, succeeded after a variable interval by shivering. Short of a distinct rigor, the patient often feels and acts as if he were cold. Twitchings, convulsions, or paralysis may ensue, and if these are isolated they indicate the area principally affected. Though surrounding such spots, diffuse encephalitis may be found. When abscess forms in the cerebral substance the membranes are prone to be affected, and occasionally, when the inflammation has been very acute, sloughs have formed in the dural covering. It is, however, much more likely that the dura mater has been perforated by molecular disintegration, owing to the ulcerative process set up by the extension of the walls of the abscess. Cerebral abscesses have burst and the contents have found their way through the external auditory meatus, or through the cribriform plate of the ethmoid. But it is questionable whether, in these cases, the pus was not extra-dural. The time when abscesses may be expected to form, after an injury to the head, is variable. They have been seen on the fifth day, most likely in such cases originating in a contused cerebral area. When arising from injury to the skull with suppuration of the bone, brain-abscess may be looked for two or three weeks subsequently. From caries of the petrous bone it may arise at any period, the patients being liable to abscess-formation as long as the caries exists. All lesions of the bones of the skull, whether traumatic or idiopathic, are much more prone to induce abscess in the brain when the parts so affected are permitted to become septic. From the nose, the orbit, the antrum of Highmore, inflammatory products have been transmitted to the brain, causing abscess. Disease in the middle ear and caries of the mastoid are apt to set up suppuration in the mastoid cells. As a rule, in such cases the membrana tympani is perforated, and a purulent discharge escapes. When suppuration is set up in the mastoid cells there is generally pain or tenderness behind the ear, and sometimes this is followed by redness and swelling. Headache is constant, and cerebral disturbance frequent. Twitchings or paralysis of the facial muscles, arising from irritation or compression of the facial nerve, frequently occur.

The symptoms characteristic of encephalitis ensue on extension of the inflammatory action inwards. It must be borne in mind that abscess of the temporal lobe may attain considerable dimensions without inducing localising symptoms; this part of the brain, not containing any direct motor tracts, and there being no case on record of disease of the cortex of the temporo-sphenoidal lobe having given rise to deafness. In such cases symptoms of compression are present, and if these are taken in conjunction with the existence of otorrhœa, and especially if they occur in children, a probable localisation in the temporal lobe may be made. When the base of the lenticular nucleus is involved, causing compression of the internal capsule, various sensory disturbances may be induced, along with partial hemiplegia. Compression of the cerebral peduncle is sometimes found in such cases, as evidenced by paralysis of the oculo-motor nerve. The discharge from the ear frequently ceases shortly before the onset of severe symptoms. This may be accounted for by the swelling of the lining membrane, and, owing to the discharge not finding exit, the disease is apt to spread through the thin lamina separating the mastoid cells from the dura mater. The inflammatory action may also spread along the veins. The most constant of the emissary veins runs through the mastoid foramen, and connects the lateral sinus with the posterior auricular vein or with the occipital. It has been averred that inflammation of each portion of the ear is transmitted to a particular region of the brain. Thus inflammation of the external auditory meatus is said to induce suppurative inflammation in the cerebellum and in the lateral sinus; inflammation of the cavity of the tympanum to give rise to abscess in the cerebrum; and inflammation of the labyrinth to produce inflammation of the medulla oblongata. There are not sufficient data to warrant a definite conclusion on these points. It is true that abscesses of the brain arising from affections of the ear are found most frequently in the hemispheres, occasionally in the cerebellum, and rarely in the pons. When disease of the mastoid cells occurs in early life, abscess is most prone to affect the cerebrum; when it arises late in life the cerebellum is most apt to be the seat of disease.

The differential diagnosis between meningitis and encephalitis is in many instances difficult and in others quite impossible. Some information may be derived from the date of the appearance of the symptoms after the accident. When inflammation arises from punctiform ecchymoses and intense congestion following severe brain-shaking, as in some forms of concussion, the symptoms appear very early —within the first forty-eight hours. In contusion of the brain, especially when localised, the inflammatory symptoms manifest themselves in four to seven days after the injury; whereas in inflammation spreading from injury of the bone to the membranes, it generally does not manifest itself till a much later period, often weeks after the accident. But though this periodicity existing between the injury and the appearance of the cerebral symptoms does frequently occur, it cannot be implicitly relied on as a differential sign. Thus the writer has seen a case of compound fracture of the skull, giving rise to meningitis—as evidenced by symptoms—on the second day, and proving fatal within the first four days after the injury. A diagnosis may be made with greater probability between meningitis and encephalitis by ascertaining whether there are any external signs suggestive of the former. If there be a contusion of the scalp without a wound, one ought to ascertain the state of the bone underneath by making an aseptic incision on the appearance of inflammatory symptoms. If the bone be found bare, much contused, fractured, or otherwise injured, it is probable that the inflammatory symptoms are due to meningitis beginning in the dura mater. If any of these injuries are associated with wounds, they may then more readily give rise to meningitis. But if the wound is not aseptic, there is a probability of cerebral inflammation due to infective infiltration or pyæmia; and if the symptoms occur a week or longer after an injury there is reason to fear the presence of this serious affection.

Treatment.—The patient ought first to be thoroughly examined. Besides investigating the functions of the brain, those of the other viscera, especially the kidneys, should receive careful attention, as by so doing symptoms which otherwise might be obscure may be at once traced to their source and treated intelligently. If there be a wound it ought to be scrupulously attended to, the most rigid antiseptics being employed. The temperature ought to be carefully watched throughout, as it is a valuable guide to the patient's condition, a rise often heralding serious changes, such as convulsions. The patient ought to be kept in a quiet room and in a subdued light. In all cases the head may be shaven with advantage, as it relieves the headache, at least temporarily, and facilitates after-treatment. The head may be kept a little higher than usual, but this may be regulated according to the patient's desire. During the whole course of the disease the food ought to be of the lightest and simplest description, milk being probably the best. The bowels ought to be carefully regulated throughout; free purgation is one of the most important points, especially in the early part of the disease, the symptoms being often relieved by the administration of a brisk purge. For this purpose mercurial preparations, especially calomel, are very valuable, some ascribing to them a special action over and above their purgative property. Those who advocate this special action advise that they should be pushed until the gums are touched. Many, however, believe that salivation is quite unnecessary, and with them the writer agrees. Croton oil is of great service in such cases, more especially when there is inability to swallow or insensibility, rendering the administration of other medicines difficult. One or two drops should be placed on the handle of a spoon and rubbed on the back of the tongue; or, if the patient can swallow, the oil may be given in sugar or other vehicle. Enemata also are of service as an aid to the purge. Then there are certain remedies the efficacy of which in such cases may be considered doubtful. These are stimulants, opium, blisters, the application of cold, and blood-letting.

Stimulants, if ever required, which may be doubted, ought to be given with the greatest circumspection. They are very apt to do harm. Opium has been advocated in certain delirious conditions ensuing in encephalitis. It tends to the production of internal congestions, and therefore ought to be avoided. Bromide of potassium, or even chloral, may be substituted when medicines of this kind are required; but the exhibition of such drugs is apt to obscure the symptoms, and that at a period when time is of great value. Blisters ought not to be resorted to in the acute stage. They are of service, however, in chronic encephalitis. It has been advised to place them over the nape of the neck. When applied in this position, the raw surface which is left is very apt to become irritated from friction, owing to the restlessness of the patient. It is, on the whole, better to put the blister on the vertex, and it is equally efficacious. The application of cold to the head is highly lauded. It may be applied in several ways, such as by evaporating lotions, by ice enclosed in bladders or in india-rubber hoods, or by a continuous current of water passing through a bag or coil of tubing. Evaporating lotions are often soothing to the patient, and are not likely to do harm. Ice applied to the head in bags is uncomfortable, and is frequently a source of great annoyance to the patient, both from its hardness and the frequency with which it has to be changed.

The best form of applying cold to the head is by some apparatus through which a constant current of water is passed, cold being substituted for that which has been slightly heated by contact with the layer next the surface of the head. For this purpose Dr. Robertson's water-bags are very suitable. They are made of thin india-rubber with an afferent and efferent tube attached to opposite corners. The former of these is inserted into a basin containing cold water, which may be iced if wished, and the current is established and maintained by syphon action. Leiter's tubes, of flexible metal, have subsequently come into use, and they answer the same purpose. When neither of these is at hand, the practitioner may substitute for the latter a piece of india-rubber gas-tubing, which may be formed into a coil and applied to the head. As these are usually lined with spiral wire, they do not collapse under the weight of the head. A string may be tied to one extremity of the tube to regulate the outflow by diminishing its calibre. Cold applied in any of these ways undoubtedly causes a contraction of the vessels of the scalp; but is it sufficient to produce the same action in the interior of the brain, and, if not, does the contraction of the superficial vessels not induce a greater turgescence in the interior of the brain? When one considers the large quantity of blood which is passing through the brain, it must be apparent that the local application of cold to the surface cannot have much effect on the deeper structures.

The employment of blood-letting in the early stage of brain-inflammation is almost obsolete, though some surgeons still believe in its value when judiciously used.

Treatment of intracranial suppuration.—Whenever the inflammation has passed into an acute stage, the surgeon should be prepared for the advent of suppuration. This may be indicated by symptoms of compression, convulsions, paralysis, &c., the careful observation of which may lead to localisation of the affection, this being the principal step toward establishing a correct treatment. If there is a wound leading to bare bone, or superficial signs of local injury or the existence of Pott's puffy tumour, it would be right to make out whether there is suppuration under the skull at that part by elevating the bone. But suppose the indications afforded by convulsive movements, by paralysis, or otherwise, should indicate that another brain-area is involved, which should the surgeon prefer as a guide: the superficial appearance of injury, or the motor or sensory signs, pointing to a lesion situated elsewhere in the brain? If the latter are distinct and show a precise localisation, they are much to be preferred. The writer has had cases illustrating this. One of them is as follows: A lad was seen by him suffering from cerebral abscess, with symptoms pointing to a localisation in the base of the third frontal convolution, but with a superficial lesion situated in front of the brow. The abscess was found in Broca's lobe, and not near the point of bare bone, which was the seat of injury. Other cases of even more pronounced character have been seen, where the traumatism apparent on the surface did not guide to the area of cerebral compression, which, however, was marked by motor symptoms, pointing to another region. These would lead one to the conclusion that motor symptoms, when sufficiently pronounced, are more to be relied on than the mere appearance of injury on the external surface of the scalp as indicating the seat of the cortical lesion. When, however, such external indications are combined with symptoms localising the lesion at the same spot, the diagnosis is rendered the more certain. It must be borne in mind, in the absence of localising symptoms, that the brain may be injured at a part opposite to that of the external injury, arising in such cases from *contre-coup*.

Regarding the localisation of the lesion, twitchings and convulsions are of great service, especially when confined to a particular set of muscles, or to one limb, or even to both limbs of one side. But inasmuch as many convulsions, though at first limited and following a definite order, soon become general, and thereby their distinctiveness as motor localising elements is lost, it is necessary to have the onset of the convulsions closely watched. It will be fortunate if the surgeon can see the onset of these attacks himself. But he cannot always be with his patient, and if he leaves, even for a short period, a seizure may take place in his absence, and its valuable indications be lost. Under such circumstances, is there no method whereby these convulsions might be watched, or data from which their advent might be expected? Accurate thermometric observations will frequently give a forewarning of the approach of convulsions, as indicated by an acute rise in the temperature within a comparatively short time. An intelligent nurse, trained to watch such cases, and whose word can be implicitly relied on, is invaluable, not only in carrying out the treatment, but as an instrument of observation. She ought to be instructed to record the temperature every two hours, and she ought to be prepared to note down the order in which the particular parts of the body twitch or become convulsed. On any sudden increase of the temperature the surgeon should be at once apprised of it, so that he may be able to be present at the beginning of convulsive movements.

Suppose that the abscess be traced to a particular locality of the brain, is it to be left alone, or are its contents to be allowed to escape? If the surgeon has the ordinary antiseptic means at his disposal, he ought to evacuate the contents of the abscess as soon as its locality is clearly recognised. For this purpose the skull ought to be opened. Before doing so the head ought to be freshly shaven. The skin should be washed with soap and water—a flesh-brush being used. It should then be cleansed with turpentine to remove any greasy matter, and finally with the antiseptic which is to be employed during the operation. In such cases the writer has always operated under a carbolised spray, and the whole operation has been at all times carried out under antiseptic precautions. The bone may be elevated in several ways. Some have advised the use of a mallet and chisel—a most objectionable practice. Others saw a triangular or rectangular portion of bone, which they then elevate, leaving it attached to the soft parts at one side, which act as a hinge, and enable the bone to be folded back. The writer has used this method on two occasions. It is suitable for cases where a large portion of the brain has to be brought into view. It, however, takes longer than trephining, and is not free from other disadvantages.

Trephining—the removal of a disc of bone by a cylindrical steel saw—is the easiest method of removing bone from the skull. The surgeon should be in possession of crowns of various sizes, which he may use as the case requires. For exploratory purposes, and especially when he believes there is pus located between the dura mater and the bone, a disc mounted in a drill-handle, and measuring not more than one quarter of an inch in diameter, is very serviceable. A small aperture is made by this means, which may be readily filled up, and through which a meningeal abscess may be evacuated. But when the abscess is situated in the brain, a large disc of bone ought to be removed. The ordinary trephine used in this country is imperfect. An instrument of the nature of the French trepan is much preferable. Sinuses must be avoided. When a sinus has been opened by mistake, a plug of catgut may be introduced. Firm digital pressure on the walls of the sinus against the bone for five consecutive minutes has been in one instance effective in stopping the flow. When the dura mater has been exposed, if the abscess is superficial the dural membrane bulges into the aperture in the skull, and there will be no cerebral pulsations visible. Occasionally the dura mater will be found to be already perforated by ulcerative action, and then the matter will ooze out or well away as soon as the disc is removed. But if this has not taken place, the membranes should be opened with a sharp bistoury. The pia mater, if inflamed, will be softened, and be of a dull leaden hue, and probably adherent to the cortical substance as well as to the external coverings.

Provided the localisation has been clearly made out, and the abscess is seated in the white matter, an incision ought to be made into it. Occasionally the brain-tissue in the vicinity of the abscess is softened to such an extent that the substance immediately fills up the incision made with the thin-bladed bistoury, so that the escape of pus is hindered. Most frequently the pent-up pus escapes with ease. A hollow needle might be employed when the abscess is deeply seated, as the pus might drain slowly through it. After the evacuation, the aperture ought to be carefully dressed, free drainage being established, the head being kept in the best position for that purpose. Subsequently the head should be dressed only when the temperature gives indications of mischief, or when the dressings show the slightest stain. The patient ought to be carefully attended to, the bowels kept regular, and the diet low. He should be kept quietly at rest in bed until the wound has thoroughly healed. He ought not to be allowed to move about sooner than a month under any circumstances. Any precipitancy in allowing the patient to go about, or any excess in diet, may lead to serious consequences.

William Macewen.

ENCEPHALOCELE. *See* Meningocele.

ENCEPHALOID CANCER. *See* Carcinoma.

ENCHONDROMA.-When non-malignant, this class of tumour is composed of cartilage only, or, if mixed with fibrous tissue, mainly of cartilage. Cartilaginous tumours, when originating in bones, which are their principal seats, are found either as central growths or—much more frequently—as outgrowths; and in this latter form the tumour may be either single—in which case the part involved is usually near the end of one of the larger long bones —or multiple, when the smaller long bones of the hand or foot are affected.

Tumours consisting largely of cartilage occur occasionally in the testis, in the tumours connected with the salivary glands —notably those of the parotid—in lymphatic-gland and connective-tissue tumours.

Cause.—Seeing that so many of the multiple enchondromata are found growing in young patients, or can be traced back as having commenced in early life, it seems probable that the cause of these tumours is to be found in errors of development, of the nature either of over-production, or rather of an irregular overgrowth of the rudimentary cartilage-elements. Of those tumours which occur later in life, either as single tumours around a long bone or mixed with other tissues in glandular growths, no special cause can be given.

Pathology.—In minute structure cartilaginous tumours may be said to correspond almost exactly with fœtal cartilage, consisting of stellate cells embedded in a hyaline matrix. Single tumours affecting the ends of the long bones grow to an enormous size, yet but seldom invade the contiguous joint. In the area of their bases of attachment to the bone they are prone to ossification, and in other parts to undergo cystic degeneration, well-defined spaces being formed, filled with a viscid mucoid fluid. In the multiple enchondromata, on the other hand, growth seems after a time to be arrested, and, beyond the inconvenience or disfigurement, they cease to cause anxiety. The central tumours are encapsuled, and are surrounded by a wall of compact bony tissue.

A feature in the pathology of some enchondromata which is peculiar to these amongst the tumours regarded as non-malignant, is the fact that occasionally dissemination occurs, nodules and even large secondary growths being found both in the lymphatics and in the internal organs, which have in this way destroyed the patient's life.

Diagnosis.—In the cases of multiple enchondromata, or of the single ones about the hand, the diagnosis is simple, as there is no other form of tumour with which they could be confounded, being less hard than bone, and yielding often, upon firm pressure, a 'crunching' sensation, which, when it can be obtained, forms conclusive evidence of a tumour being cartilaginous; when pedunculated they can be made to rock. The larger single enchondromata require to be distinguished from those sarcomata which may be either ossifying or chondrifying, or undergoing both of these changes; but sarcomata of this type are more prone to occur in the pelvis and bones of the trunk, whilst the periosteal sarcomata, that are found in the situations which enchondroma usually occupies, are soft and smooth on the surface and of rapid growth, cartilaginous tumours being usually of much slower growth, as well as being hard and nodulated.

Between a central cartilaginous tumour and a central sarcoma or a myeloid tumour a diagnosis cannot always be made. Of course, if the characteristic yielding sensation of cartilage can be obtained, the case is clear, but, failing this sign, the diagnosis rests upon the probabilities of age, duration, rapidity of increase, pain, and invasion of health. When cartilage enters into the composition of a glandular tumour the hardness and nodulated character of the tumour commonly render the fact evident.

Treatment.—Amputation of a finger or even of part of the hand may be necessary to relieve a patient of a member which, from the size an enchondroma has reached, has become a useless incumbrance; but we cannot say this procedure is required on account of the nature of the growth itself. So also eventually is amputation necessary when enchondroma of a large long bone has reached a size which puts a stop to locomotion or threatens life. For central cartilaginous tumours in bone the attempt should be made to enucleate the growth, and this will generally prove feasible, unless the surrounding bone has been reduced to a mere shell. A. WILLETT.

ENDOSCOPE.—The endoscope is an instrument designed for the direct exploration of internal organs and cavities by the sight. There is no portion of the human body, into which a straight tube can be introduced, in which it may not be employed profitably. By its aid we can examine the urethra, bladder, rectum, uterus, nasal fossæ, pharynx, larynx, external meatus auditorius, wounds, cavities of abscesses, and so forth. In its most perfect form curved tubes may be used as endoscopic specula.

This instrument, which is one of the numerous modern adjuncts to physical diagnosis, dates back to the early part of the present century, when we find Bozzini of Frankfort, in 1806, using his 'light conductor.' In 1824, Dr. J. D. Fisher, of Boston, devised an instrument not unlike that in use at present, and shortly after, Segalas, of Strasbourg, followed his example. Later on, Bombalgini, Avery of London, and Hacken of Riga, added their labours and experiences, thus far, unfortunately, unprofitable.

In the year 1865, Desormeaux, of Paris, published his remarkable essay on the subject of endoscopy, and from that date to the present time this mode of exploration has been used more frequently, scientifically, and fruitfully than before.

It will be right here to define what may be fairly considered the real value of the endoscope as a means of diagnosis and treatment. The writer holds that it is not an instrument needed for general use, but rather one for employment in cases of exceptional obscurity, in which its help will be found to make all the difference between blundering guesswork and absolute certainty.

The following may be taken as a general description of the instrument.

In the first place there is a tube or speculum, which is introduced into the canal or cavity to be examined; and at one extremity of this a mirror of polished silver, perforated in the centre, is placed at an angle of 45 degrees. The function of the mirror is to reflect the light, which is placed laterally, into the tube, so as to illuminate it to the end. As the calibre of the tube is usually very small, a most brilliant light is required, and, in order to obtain the best effects, it should be made to converge slightly upon the mirror. This convergence is obtained by interposing between the light and the mirror a plano-convex lens of suitable focal length.

The light being sufficient, the lens properly adjusted, the mirror bright, and correctly placed with respect to the speculum tube, it becomes a matter of facility for the eye of the observer, looking through the aperture in the mirror, to see clearly to the bottom of the speculum, and recognise whatever may lie there. Various specula are required for endoscopy. The urethral tube is the most generally useful, but special ones are needed for the examination of the bladder, rectum, nasal fossæ, auditory meatus, &c.

Various lights have been tried for obtaining the needful illumination—sunlight, ordinary daylight, the Drummond, magnesium, and electric lights. As a rule they are toys in endoscopy, and not practically useful. Desormeaux uses a gazogene lamp of minute dimensions, which gives a very insufficient view. After numerous and prolonged experiments the present writer has arrived at the conclusion that nothing equals, for the purpose, the intense light derived from the thin edge of the flat flame of a small paraffine lamp.

Before concluding, a few examples of the value of endoscopy, *in cases of obscurity*, may be here cited.

Case I. In the autumn of 1865, Dr. S. consulted the writer, by letter, relative to extreme irritability of the bladder, from which he had suffered for six months, and for which he had taken, in vain, the advice of two very eminent London surgeons, one of them a specialist of the highest skill in diseases of the urinary organs.

Dr. S. came to Dublin for examination, when the writer found him a hale man of about sixty years of age, in good health except for the irritable bladder, which necessitated his passing water every ten minutes, and totally disabled him from performing the duties of his profession. The urine exhibited, after standing some hours, a very slight deposit of muco-pus; otherwise it was healthy, of good specific gravity, acid reaction, and containing no greater amount of albumen than was accounted for by the minute quantity of muco-pus.

With the assistance of Dr. Robert MacDonnell the writer made a careful endoscopic examination of Dr. S. The urethra and bladder were found healthy, with the exception of a small patch of superficial ulceration, or rather abrasion of the mucous membrane, in the site of the trigone. This lesion explained the whole case. The moment the urine reached this spot the irritation began, and could not be assuaged except by emptying the bladder. The indication for treatment obviously was to heal up this abraded surface.

Local measures being far more likely to attain that end than drugs, an instrument was constructed (a canula open on the curved aspect) with which the writer easily conveyed a watery solution of nitrate of silver to the part (gr. x.–f ℥j). A few applications dulled the sensibility, and made Dr. S. more comfortable, and after a time he was allowed to return home, and directed a daily injection of the bladder (previously emptied) with a solution of nitrate of silver, (gr. j.–f ℥j). The case progressed steadily, and in four months a perfect and permanent cure was effected.

Case II. In the year 1866, the late Dr. Fleetwood Churchill, senior, asked the writer to examine a young lady who suffered from an extraordinary irritability of the bladder. Dr. Churchill had ascertained that there was no stone, and that the urine was perfectly normal. An endoscopic examination of the bladder demonstrated its perfect healthiness, the whole surface presenting the mamillated rose-red surface familiar to the trained endoscopist. The absence of bladder-disease led the writer to suggest an intra-uterine examination, which showed a closely contracted cervix, with diseased lining membrane.

To facilitate further investigation Dr. Churchill dilated the cervix with the sea-tangle bougie, and from that time the irritability of the bladder disappeared. In this case the perfect healthiness of the bladder, proved by the endoscope, suggested the reflex origin of the symptoms, and treatment of the uterine disease effected an immediate and permanent cure.

Case III. Mr. R., aged about forty years, had long suffered from rectal hæmorrhage, which latterly threatened to undermine his health. He had become markedly anæmic, breathless on exertion, and lost all appetite. Careful examination of the rectum with the ordinary speculum had already failed to discover the cause of the bleeding.

An endoscopic examination cleared up the difficulty, and enabled the writer, and Dr. Tegart, to see a bleeding growth, situated so high up in the bowel as to be beyond the reach of the ordinary speculum. Mr. R. was conveyed to Dublin, and on the 11th of April, 1876, assisted by Dr. Tegart and Dr. P. Hayes, the writer succeeded, with great difficulty, owing to its unusual position, in ligaturing the vascular tumour. The result was a perfect cure of the hæmorrhage, and in a few months Mr. R. completely regained his health and condition.

The three foregoing cases have been selected from amongst many, to illustrate the help which may be gained by the use of the endoscope, towards precise diagnosis and effectual treatment, in certain obscure ailments of the bladder, uterus, and rectum.

F. R. Cruise.

ENTERECTOMY, or excision of a part of the small intestine, has been performed for the relief and cure of the following conditions:—Simple and epitheliomatous strictures of the small intestine; occlusion of the bowel by adhesion and matting of the coils, of such a character that the deviation of the gut cannot be corrected; obstruction by non-carcinomatous neoplasms; gangrene due to the various forms of strangulation and to hernia; irreducible or gangrenous intussusceptions, and for the closure of fæcal fistula.

It will be seen that under certain of these circumstances the operation not only serves to remove the obstruction, but to cure the condition which produced it. In certain of the conditions named, such as in the various forms of stricture, in obstruction by large tumours, and in irreducible intussusceptions, the operation offers the only chance of cure, while other measures short of resection can only bring about a temporary relief.

There are two different methods of performing the operation. In the one the diseased segment is excised, the divided ends of the bowel are then at once united by sutures, the parts so adjusted are reduced into the abdominal cavity, and the wound in the parietes is closed. In the other, after the resection has been performed, the divided ends of the bowel are stitched to the margins of the wound in the parietes, and an artificial anus is established. After a certain interval, the artificial anus is closed by a second resection operation with immediate suture, or by some of the other measures available for the treatment of such abnormal apertures.

1. In the first mode of procedure the abdomen is opened by an incision in the linea alba below the umbilicus. The portion of gut to be resected is drawn out of the wound. The wound is then plugged round about the gut by means of warm carbolised sponges, so that, should the intestinal contents escape during the operation, they may not find their way into the peritoneal cavity. The bowel must now be occluded both above and below the part that is to be excised. This can be accomplished either by the fingers of an assistant, or by means of the various clamps invented for the purpose (Rydygier's, Bishop's, Makins', or the writer's). The portion of gut is now to be excised with scissors, and a triangular piece of the mesentery resected, the base of the triangle corresponding to the segment of bowel removed. The divided mesenteric vessels are secured, and the cut edges of the mesentery approximated by several points of suture. The divided ends of the bowel are now approximated and united by sutures. A number of sutures are first to be applied so as to unite the edges of the mucous membrane, that membrane being freely exposed by the retraction of the muscular coat. An outer line of sutures is then applied so as to bring the serous surfaces of the two pieces of gut into close contact. The best suture for this purpose is that known as Lembert's. In all, some 40 points of suture are required, 15 for the inner row and 25 for the outer. The best material for the purpose is the finest Chinese twist, and the needle used should be very fine, round on section, and so curved as to form half a circle. Hagedorn's needles are very well suited for the purpose. The clamps are removed, the bowel is returned into the abdomen, and the wound in the parietes is closed. After the operation the patient must be kept well under the influence of opium, so as to insure the absence of movement in the bowel. The patient may have ice to suck, but no food should be given by the mouth for at least three days, and then it should be given in small quantities, and in a fluid form. If necessary the patient's strength may be supported by enemata of brandy and peptonised beef-tea. Such enemata are, however, contraindicated if they induce undue peristaltic movements.

2. In the second mode of procedure, a portion of intestine and a triangular piece of the mesentery are excised, as in the method just described. The gap in the mesentery is united by a few points of suture, and the divided ends of the intestine are so adjusted to the margins of the wound as to establish an artificial anus. This fistula is subsequently closed by a second resection operation, followed by suturing of the divided ends and closure of the abdominal wound. Or it may be closed by any other of the measures applicable to the cure of ARTIFICIAL ANUS.

There is no doubt that in cases of intestinal obstruction the second operation is infinitely preferable to the first, and should be the procedure selected in such cases. It must be borne in mind that the patients' lives are threatened by reason of the obstruction, and it will be seen that the latter of the two procedures detailed above will give the most ready and complete relief. The sutured bowel, when returned into the abdomen, lies as a paralysed loop, and may well help to maintain already existing symptoms of obstruction. Besides, patients upon whom these operations are performed, are often in a critical condition, and not in a state to bear well so prolonged an operation as is the first-named. Moreover, to prevent fæcal extravasation at the suture line, the bowel should be as nearly as possible empty and in a fairly healthy condition. When the first-named of the two procedures is adopted in a case where obstruction exists, the operation is performed upon a bowel in a state of considerable distension, and upon tissues that are apt to be congested and inflamed, if not even on the verge of gangrene. The general mortality of resection operations is 50 per cent. FREDERICK TREVES.

ENTEROCELE. *See* HERNIA, Strangulated.

ENTEROTOME, Dupuytren's. *See* ARTIFICIAL ANUS.

ENTEROTOMY. — This procedure, sometimes known as Nélaton's operation, consists in establishing an artificial anus in the small intestine. The seat of the operation is the inguinal region, preference being given to the right side. An incision is made through the abdominal parietes parallel to, and from one inch to one inch and a half above, Poupart's ligament, and to the outer side of the deep epigastric artery. The incision is carried through the external and internal oblique and the transversalis muscles, and the peritoneum is divided. The skin incision should be about three inches long, but the deep incision, whereby the peritoneum is opened, need be no more than about one and a half inches in length. The abdominal cavity having been opened, the first *distended* coil of bowel that presents itself is gently seized and drawn into the wound. The gut is then fixed to the wound by a double line of sutures, which are applied in a row, one on either side of the skin incision, and which transfix the intestinal walls. An opening is finally made into the bowel between the two lines of suture, and the operation is completed. When enterotomy is performed upon the right side, as is usually the case, the part of the intestine opened is nearly always the terminal portion of the ileum.

This operation has been done for almost every form of intestinal obstruction. It affords relief, but it cannot become a means of cure since it leaves the cause of the obstruction untouched. If destructive changes are taking place at the seat of the obstruction at the time when the enterotomy is practised, they will continue to progress in spite of the procedure. The operation is performed in the dark, and is to a great extent independent of diagnosis. In several instances an artificial anus has been established in the ileum to relieve an obstruction which a subsequent autopsy showed to be situate in the sigmoid flexure. If it should so happen that a loop of jejunum is opened instead of ileum, death from marasmus will in time attend the establishment of a fistula so near the stomach. In any case much distress is apt to be caused by the accumulation of fæces between the fæcal fistula and the seat of the obstruction. There are certain cases however—as for example when obstruction depends upon the extensive matting together of coils of intestine—in which enterotomy offers the only means of saving the patient's life. Mortality:—Out of 61 recorded examples of enterotomy for non-malignant forms of obstruction, 20 are described as cured, while 41 died. Out of 48 examples of enterotomy for malignant stricture of the bowel, 6 are described as cured, while 42 died.

FREDERICK TREVES.

ENTROPION.—The edges of the lids are more or less inverted, so that the lashes are turned towards the eyeball. The lashes themselves may be regular, or they may be irregular, as in trichiasis. *See* EYELIDS. The inversion may be complete or it may be partial, and in either case it may be acute (spasmodic) or chronic (inflammatory).

ACUTE ENTROPION chiefly affects the lower lid, especially in old people (senile entropion). From the shrinking of the tissues in old age the globe recedes somewhat into the orbit, the lower lid loses support, and is turned inwards by the action of the marginal fibres of the orbicularis muscle. This is especially apt to occur when the eyes are bandaged. It not infrequently happens in old persons operated on for cataract that, when the eyes come to be tied up after operation, the lower lid becomes inverted, though previously there had been no inversion. Acute entropion may, however, occur in younger persons from injury or inflammation of the conjunctiva or cornea. In any case, the irritation of the lashes in entropion may set up inflammation and even ulceration of the conjunctiva or of the cornea. From the displacement of the lacrymal puncta there is a constant overflow of tears, which may lead to excoriation and inflammation of the edges of the lids.

Treatment.—In slight and temporary spasmodic entropion it may be enough to draw the edge of the lid outwards from time to time, or to fix it with collodion or strapping. In order to facilitate the drainage of the tears the lower canaliculus should be opened. Should these simple measures fail, an elliptical fold of skin may be excised from the outer surface of the lid and close to the margin. The size of the piece of skin will depend upon the amount of inversion and the length of time that it has lasted. After removal of the skin a strip of the most marginal fibres of the orbicularis may also be removed. Sutures may be applied, or not. In order to increase the effect of the operation, a snip, one-eighth of an inch deep, may be made on the edge of the lid close to the external angle. This divides those marginal fibres of the orbicularis muscle which are chiefly instrumental in producing the inversion. Many other procedures may be resorted to, as subcutaneous sutures, canthoplasty, or division of the external canthus, Graefe's operation, &c.

Chronic Entropion.—In this form the edges of the lids are often thickened and red, and there is usually some trichiasis. The skin is not lax, as in the acute form, and the tarsus itself is generally incurved. There may be also contraction of the palpebral aperture (blepharophimosis), together with signs of chronic, especially trachomatous, conjunctivitis. The result of chronic inversion is irritation of the conjunctiva and the cornea, or even inflammation and ulceration of the cornea, with lacrymation and dread of light. Owing to the displacement of the lacrymal puncta there is epiphora. It may be the result of inflammations, or it may be traumatic and due to burns, especially with lime or ammonia. In extreme cases the conjunctival sac may be obliterated.

Treatment.—Canthoplasty may be done if the palpebral aperture be shortened; excision of an elliptically-shaped piece of skin, if there be no incurvation of the tarsus; but if the tarsus be incurved, as after trachoma, the operative procedure must be applied to the tarsus. Two methods are in use: one consisting of removing a V-shaped strip from the *outer* surface of the cartilage near the edge, 'grooving the fibro-cartilage' (Streatfeild-Snellen), the other consisting of making an incision through the tarsus from the *inner* side near the margin, and throughout its entire length (Bürow). The principle of the former is to correct the deformity by shortening the outer surface; that of the latter, lengthening the contracted inner surface. Another operation consists in splitting the margin of the lid throughout its entire length immediately within the row of eyelashes (Arlt). This procedure is especially indicated when the conjunctiva is greatly contracted. Each of the plans above mentioned attempts to retain the eyelashes; but in some instances it may be necessary to excise the lashes. J. Tweedy.

ENURESIS. *See* Incontinence of Urine.

EPHELIS. *See* Lentigo.

EPIDIDYMITIS. *See* Testis, Diseases of the.

EPIPHORA. *See* Lacrymal Apparatus, Diseases of the.

EPIPHYSES, Affections of.—These may be acute or chronic in their course, central or peripheral as regards their starting-point. They are essentially affections of infancy and childhood, though of course they may occur up to the age when the epiphyses unite with the shafts, which in some cases may be as late as the twenty-first year of life. As a rule, the acuter forms of disease are found among infants, the more chronic among older children; they are rarely primary; or, to speak more definitely, they depend either on some constitutional cachexia or on septicæmia. The diseases which commence at their line of junction with the shaft (peripheral) are more common than those which commence in the interior of the epiphysis (central). The so-called epiphysitis, in many cases is an inflammation along the line of junction with the shaft, and more often due to disease in the shaft than in the epiphysis; the integrity of the latter being shown by the continued growth of the diaphysis, and explained, probably, by the immunity which non-vascular structures enjoy over more vascular ones in early life.

Causes.—By far the commonest cause of the acute affections of the epiphyses is some congenital dyscrasia, especially inherited syphilis. Though much less frequently, acute rickets and scurvy also lead to acute inflammations at or near the epiphysial line, which may be followed or not by disease of the epiphysis. Septicæmia is another cause, and this variety of lesion, usually multiple, is more acute and more destructive than any of the foregoing. In all the forms, injury—traction on joints during parturition, sudden jerks, blows, falls, &c.—is often the more immediate cause. In the chronic forms, injury again plays an important part; occurring in later childhood, the strumous diathesis is often the predisposing factor. In a few cases, even in which there does not appear to be any constitutional dyscrasia, blows or falls set up acute or subacute disease in the ossifying centre of an epiphysis, apparently by detaching it from its connection with the surrounding part, or in consequence of hæmorrhage or of mere concussion; the centre either dies outright, or takes on subinflammatory changes which lead to abscess, or to arthritis.

Pathology.—The pathological anatomy varies within considerable limits, depending on the stage of the disease when examined, or on the acuteness of the process, and a little also on the nature of the initiatory lesion. In all the peripheral affections, at the line of junction with the shaft, and in the soft, most recently formed osseous layers there are hyperæmia and exudation of cells.

The amount will vary in proportion to the acuteness of the process. In congenital syphilis, this exudation may be so abundant as to allow the epiphysis to move freely on the shaft; in some cases the epiphyses appear to be quite separated; suppuration is rare, but sometimes occurs. As a rule this exudation-material is sanguineous, it is contained within the periosteum, and rarely shows any tendency to point externally, the adjoining part of the shaft not rarely participates in the disease; complete recovery may take place under suitable treatment. In acute rickets a very similar condition may exist, but it rarely assumes the same extent; the bones become extremely vascular and softened, so that fracture not infrequently results. In some forms of infantile scurvy also, an acute inflammation of the diaphyses of the long bones occurs, which may compromise the epiphysis. In septicæmia, the shafts of the long bones are often the starting-points of the disease, and the epiphysis becomes secondarily implicated; or, beginning within a joint, disease spreads to the line of junction, thence to the shaft if, as in the hip and shoulder for instance, the epiphysis happens to be within the joint-capsule. In all the foregoing cases the affection is more often multiple, the attacks not necessarily occurring all at once, but in rapid succession; sometimes the chief violence of the disease expends itself on one joint or bone, while the remainder are less profoundly affected.

Under the term 'acute arthritis of infants' Mr. Thomas Smith has described cases which include the septicæmic variety, and—as the writer of this article thinks—other and more distinctly epiphysial conditions, the feature in common being arthritis. In a few cases, epiphysial disease proper may be acute, and lead to arthritis or abscess; it is then mostly in consequence of necrosis or caries in the ossifying centre. But more generally the change is a chronic one, the centre becomes inflamed and caseous, pus forms slowly, and before making its way out, or towards the joint, it gives rise to chronic inflammation and to pulpy thickening of all the soft surrounding tissues. On making a section through such an epiphysis, a cavity is entered, lined with pale, semi-caseous granulation-tissue, and containing what remains of the ossifying centre as a loose sequestrum.

Symptoms.—The symptoms vary as much as the pathological conditions. A pseudo-paralysis of one or more limbs, coming on rather suddenly, attended with pain on handling, with swelling at or near a joint, and occurring in a syphilitic infant, would be almost pathognomonic. A similar condition, occurring in an older child without signs of syphilis, but with the history and evidences of improper hygienic surroundings, would almost as certainly indicate an acute onset of rickets. In young strumous persons, the affected epiphysis excites a little general infiltration of the adjacent soft structures, with a subsequent formation of pus, which is the not infrequent starting-point of joint-disease. In such cases, the acuteness of the process rather modifies the symptoms, and may even mask the disease.

Prognosis.—The syphilitic and rachitic and scorbutic varieties possess unbounded powers of repair under suitable treatment. Where necrosis has actually taken place, the subsequent growth of the limb will almost certainly be impaired: if the diseased epiphysis communicates with a joint, prognosis as regards joint-function must be guarded. In the septic, multiple forms the disease is often fatal both to life and limb.

Treatment.—Generally, for all forms, fixation and rest of the affected limb or limbs are of first importance. Many cases are fatal for want of early recognition of the condition, and as the result of raising the child by its limbs, or of allowing them to dangle as it is turned about; much of the actual separation which takes place is due to lifting or handling the child. In the syphilitic cases, a piece of flannel covered with mercurial ointment should be evenly wrapped round the affected limbs, and over this several turns of soft bandage to act like a splint: this dressing need not be disturbed for two or three days. The limbs should be fully extended and in their normal position; the child must not be carried about, but be allowed to lie on a soft pillow, and be moved as little as possible, or when moved, moved on the pillow. All unnecessary clothes and sleeves should be avoided. Mercurial inunction into the abdomen may be practised simultaneously. Improvement will generally be manifest within a few days; while the low constant cry of pain will probably cease from the moment that immobility of the affected limbs is secured. In rickets or scurvy, evaporating lead lotion made with milk should be substituted for the mercurial ointment, but the same immobility with soft bandages should be secured; cod-liver oil, fresh uncooked pounded meat, fruit-juice, with attention to hygienic details, will effect a marvellous change in a few days. In the chronic cases, an attempt should be made to save the joint. If an abscess point it should be incised freely, and the diseased bone gouged out, if it can be detected with a probe. Not infrequently a central necrosis of the epiphysis will be found; after its removal, the cavity must be scraped out with a sharp spoon, and then filled with some dry absorbent antiseptic wool. Cod-liver oil internally, with change of air to the seaside, are powerful adjuvants in such cases. The secondary affections of joints, if not too far advanced, often subside spontaneously after the exciting cause has been removed; hence the indication is to temporise as long as possible in the hope of restoration without operation. Robert William Parker.

EPIPHYSES, Separation of. *See* Separation of Epiphyses.

EPIPLOCELE. *See* Hernia, Strangulated.

EPISPADIAS. *See* Ectopia Vesicæ.

EPISTAXIS is the term applied to bleeding from the nose, on account of the tendency to 'drip' usually characteristic of the condition.

When *accidental*, the bleeding soon ceases spontaneously in most instances, at any age, especially if resulting from a fall or other blow on the nose, with or without fracture of one of the superior maxillary bones. In rare cases it attends fracture of the base of the skull through the ethmoid bone, as indicated by a subsequent discharge of serous fluid.

Under circumstances of *operation* for the removal of nasal polypus, necrosed bone, or foreign body, the epistaxis may be profuse to a dangerous extent, and require prompt arrest.

In *disease*, epistaxis is apt to accompany malignant nasal tumours, when ulcerated on the mucous surface.

Under other circumstances, *spontaneous* epistaxis varies in severity and danger. In young anæmic persons, or others liable to headache, and in women liable to suppressed menstruation, bleeding from the nose produces relief which more than counterbalances the inconvenience of the flow. Full-blooded persons benefit by a tolerably copious hæmorrhage of this sort; but in middle life and old age it sometimes proves intractable, dangerous, and even fatal.

Treatment.—Whatever be the cause, the arrest of copious or persistent epistaxis should be promptly attempted, except in cases obviously benefited by the occurrence. (1) The first, simplest, only instantaneous means, under all circumstances, at hand, is the adoption of the proper attitude of body. In the standing posture the general vascular tension is at its highest, less in the sitting, and least of all in lying down. In any posture the elevation of the upper limbs, with the hands at their highest, promotes the contraction of the arteries to the head as well as to the lower limb, and instantly arrests epistaxis in many cases. The lying, or at least reclining, posture, and elevation of the arms, should therefore be promptly enforced in the first instance.

Other means may be required, but this is the proper and only sensible thing to begin with, and may be enough if the patient can also be kept still, composed, and reassured. It is not essential that the head should always be kept low, for the head and shoulders can be raised sufficiently for all convenience without departure from the general reclining posture, the attitude of most perfect rest to the heart and blood-vessels.

The next most effectual means are (2) the irrigation of the nose with hot water (*see* Nasal Douche); (3) the subcutaneous injection of ergotin (*see* Ergotin); and (4) plugging the nose, which should never be undertaken unless (2) and (3) have failed. For the last process, both efficiency and comfort have been attained by the use of little bags of india-rubber having a tube attached, and capable, on inflation with air or injection with water, of exercising effectual pressure on the walls of the nasal cavity and arresting the flow of blood. There are two or three varieties of nasal plugs, each of which is introduced, in a collapsed condition, into the nostril, and inflated when *in situ*, with an india-rubber ball, force-pump, or with the mouth. Dr. Wiglesworth's plug is passed behind the posterior nares, inflated, and pulled forwards till the aperture is stopped; the tube is attached to an ordinary plug of lint in the nostril.

The old-fashioned mode of plugging with lint is both difficult, disagreeable, and painful, but as a last resource it has sometimes to be done. A piece of lint, plain or steeped in perchloride of iron, solution or tincture, is folded to fit closely into the posterior nares, to which situation it is drawn through the mouth by a piece of string tied round its middle, and previously passed in at the nostril, round behind the palate, and out at the mouth. This manœuvre is effected with the aid of a urethral catheter, or by a special contrivance called Bellocq's sound, resembling a curved metal catheter, and containing a flexible spring on a stilette, for protrusion into the mouth when the instrument lies in the nose and pharynx.

When the pharyngeal end of the nasal cavity is plugged, the nostril is then plugged with another fold of lint of suitable size, and tied there with the ends of the string attached to the posterior plug, one of which issues from the mouth and the other from the nostril.

The inconveniences and discomfort of this process are so great that it should never be undertaken if it can be dispensed with. Rushton Parker.

EPITHELIOMA. *See* Carcinoma.

EPULIS. *See* Gums, Affections of the.

EQUINIA. *See* Glanders.

ERECTILE TUMOURS. — These curious swellings, known also under the names of vascular tumours, cirsoid aneurism, arterial varix, teleangeiectasis, and angeioma, may be shortly described as consisting of tortuous vessels or cavernous sinuses freely communicating with each other, and also with greatly enlarged arteries and veins. Occasionally they pulsate, and the skin is often 'stained.' Their customary sites are the scalp and face, often involving the external ear; and at the orifice of the female urethra. Although placed commonly near the surface, the deeper structures are liable to be affected.

Occurring usually in young patients, there are cases recorded of erectile tumours following injuries.

Cause.—The occasional skin-implication denotes their kinship to nævi, and in these instances there exists a common cause suggestive of an embryonic hypertrophy of the capillaries. In the case of the tumours commencing unequivocally in adult life, an hypertrophy due either to an idiopathic or traumatic cause must be the assumed explanation of their origin.

Pathology. — The tumour-like masses consist of a congeries of dilated blood-vessels supplied by numerous arteries, which usually can be traced running into the growth and emptying into large tortuous veins. Their microscopic structure is the same as that of the corpora cavernosa penis. A change, probably of a degenerative kind, is seen in the production of cysts; but the mode in which this is brought about is not clear. Whilst cellular tissue is the structure in which erectile tumours are commonly placed, other structures—notably, the muscles—are liable to be involved in deeply-placed tumours.

Diagnosis.—When placed on the surface, the varicose appearance of the part, its soft sponge-like feel, the subsidence and welling-up again of the swelling, as pressure is either made upon it or relaxed, with the abnormally large arteries in its periphery, unite in rendering a diagnosis easy; but, when deeply placed, the symptoms of aneurism or of a malignant growth may be simulated. The writer has seen the common femoral ligatured for the disease under consideration, the operator believing he was dealing with a case of aneurism of a branch of the profunda. In a patient presenting a tumour aneurismal in character, but not in the course of any arterial trunk, and in whom the health is not affected, nor can any secondary growth be detected, the existence of an erectile tumour is more probable than of either of the others; whilst in cases of pulsating tumours involving bone, the disease will almost certainly prove malignant.

Treatment.—When it can be prudently attempted, complete removal should be performed, as the only really reliable mode of treatment; but if this is, for any cause, unadvisable, electrolysis, steadily persevered with, offers the best prospect of cure. Moreover, it should not be forgotten that these tumours, equally with nævi, may undergo a spontaneous cure, or, at all events, an arrest of growth; whilst, if irritated by ineffectual treatment, they are prone to enlarge. It is well, therefore, to be satisfied that a necessity for interference exists before putting any plan of treatment into action. Alfred Willett.

ERGOTIN, Surgical Use of.—Ergotin is an extract obtained from ergot of rye by a process introduced by M. Bonjean. From a surgical point of view its use as a hæmostatic is that which has mainly to be considered.

M. Bonjean's method of employing it for external use is as follows:—The ergotin is dissolved in five or six parts of water in ordinary cases; in three or four only where the hæmorrhage is severe; and pieces of lint saturated in this solution are applied to the part, previously well-dried, pressure being maintained with the hand until the blood ceases to flow; should the bleeding continue, the lint is kept constantly wet with the solution; the pressure should be firm, but not sufficient to interrupt the circulation. The lint should not be removed for three or four days. Ergotin may also, of course, be administered internally; but all accounts seem to show that this is the most uncertain and least satisfactory way in which it can be used. Hypodermic injection is, beyond question, the best, and therefore the only method which the writer proposes to consider.

Hypodermic injection of ergotin has been practised, and according to reports with a certain amount of success, by Von Langenbeck and some other continental surgeons in the treatment of various disorders or diseases of the vascular system, such as aneurism, varix, hæmorrhoids; and in other tumours where the cutting off or diminution of the blood-supply appeared likely to favour cure. But it is in the treatment of various hæmorrhages that its practical utility has been most certainly demonstrated. In 1874 the writer had the opportunity of trying it in a case of epistaxis which had persisted for more than twenty-four hours, in spite of various remedies, and where plugging of the posterior nares appeared to be demanded. One injection of 3 grains of ergotin acted promptly and permanently. The bleeding had ceased before the writer left the house. Since then he has frequently used or prescribed this treatment in similar cases, and with satisfactory results, except in one instance; and there the cause of failure was no doubt due to an inferior drug, as was proved by the fact that all the injections made from this particular sample proved partial or total failures. In a case of alarming secondary hæmorrhage after the removal of a vascular growth from the base of the tongue, the writer injected 3 grains of ergotin with a like satisfactory result; a second dose was administered within the hour as a matter of precaution; the hæmorrhage never recurred, and the patient recovered. On several occasions the writer has made use of this practice to check free oozing after amputations and excisions, before closing the wound; and in some cases, the effects have been remarkable, resembling those which follow the use of the hot-water douche for the same purpose; the blood became darker, the flow more sluggish, and then in many cases the wound became studded with numerous dark points, no doubt denoting the mouths of capillaries and other small vessels.

Acting on this hint, he has for several years past been in the habit of prescribing a hypodermic injection of ergotin after operations in which, for any reason, oozing or intermediary hæmorrhage seemed likely to occur; always excepting cases where the vessels were atheromatous. To prevent failure, or subsequent inconvenience, two or three cautions may be given. In the first place, the drug should be obtained from a reliable source; for, as previously pointed out, some specimens of ergotin are worthless. Secondly, the risk of subsequent inconvenience, in the form of pain and perhaps inflammation at the site of injection, may be avoided, by thrusting the needle into *muscle*, not merely into the subcutaneous tissue; and, further, it appears advisable that the patient should lie down to receive the injection, for in one or two cases of epistaxis where the ergotin was administered while the patient was sitting up, vertigo or faintness occurred, perhaps from the sudden contraction of cerebral vessels. (It is hardly necessary to point out that the styptic action of ergotin is due to its physiological property of causing contraction in the involuntary unstriped muscular fibres of the middle coat of the blood-vessels.) The dose previously mentioned (3 grains) will in most cases be found sufficient, but may be repeated when necessary; and as this quantity is readily soluble in 10 minims of warm water, the injection is not of formidable bulk. More recently, an alkaloid of ergot (ergotinine) has been obtained, and used with very successful results; an account of which will be found in the Obstetrical Society's *Transactions* for 1882. CHAUNCY PUZEY.

ERYSIPELAS may be defined as a diffused and spreading inflammation of the skin, mucous and serous membranes, or of the connective tissue beneath them; accompanied, and usually preceded by, fever, and due to some poison introduced into the system.

Causes.—A. *Efficient.*—As to the exact nature of the poison, which may be looked upon as really producing the disease, there is considerable difference of opinion. By some it has been believed that there is a distinct and specific erysipelatous virus, similar to the specific miasma of smallpox, scarlet fever, and measles, and that the disease should be classed as belonging to the order of contagious exanthemata. The principal arguments which have been deduced in favour of this hypothesis are, that it is infectious; that it is sometimes epidemic; that the local affection is accompanied by fever; that it has, at all events generally, a period of incubation; that the appearance of the affection of the skin is preceded by an obvious disturbance of the general health, and, lastly, that it runs a more or less definite course. But against this theory is the important fact that erysipelas differs from all other exanthemata in its liability to recurrence. It is an acknowledged fact that an attack of erysipelas predisposes to a second, and a patient who has once been attacked by this disease is more prone to have it again than one who has never suffered—a marked contrast to the comparative immunity which an attack of smallpox, scarlet fever, or measles undoubtedly confers on the individual. Other minor points in which it differs from these fevers may be also noted: thus the incubation is sometimes short or even altogether absent; occasionally there is no premonitory fever; the stages are by no means uniform, and the local affection is limited to portions of the skin.

Again, others have regarded erysipelas as a purely local disease, and have based their opinion on the assumption that, if it can be shown not to be a specific disease, therefore it must be a local one. But this is not borne out by facts, for though the inflammation usually starts from a local injury or wound, it may, and sometimes does, start from quite a different part of the body from that where the injury is situated. For instance, an amputation of the foot has been followed by erysipelas of the head and face, occurring a few days after the operation, and rapidly proving fatal. Or, indeed, the erysipelas may commence without the slightest wound or abrasion anywhere, though this is by no means common. Or, again, it may attack internal parts or organs. Furthermore, it is, undoubtedly, contagious. It is usually preceded by obvious constitutional disturbance and accompanied by well-marked fever. All these arguments are strongly against the theory of the local nature of erysipelas.

Of late years the belief has been frequently expressed, and has certainly been gaining ground, that erysipelas is due to the presence of bacteria in the system—the term 'bacteria' being here used in its widest sense, as signifying micro-organisms.

Nepveu, as long ago as 1872, found them in the blood of four patients suffering from erysipelas. Orth has found them in the bullæ of erysipelas. Lukomsky has found them in the lymphatic vessels of the skin affected with the same disease. Billroth and Ehrlich have found them, not only in the lymphatics, but also in the blood-vessels. More important, however, are the observations of Von Recklinghausen, who states that, in spreading erysipelas, micrococci were found in the lymphatic spaces and lymphatics belonging to them, where the process was recent and in progress; but that where the erysipelatous inflammation was in the retrogressive stage, no micrococci were present. In other words, they were present only in what may be termed the progressive zone, at the edge of the extending inflammation, and *not* in the tissues at a distance from the margin of extension. The discovery of bacteria in the tissues affected with erysipelas does not, however, substantiate the germ theory; something further than this is necessary. It must be proved that these organisms, which have been seen to exist in the tissues affected with erysipelas, are the true causal agents of the disease. This has been done by a series of conclusive experiments conducted by continental observers. Orth injected under the skin of a rabbit the contents of an erysipelatous bulla, in which he had satisfied himself, by microscopic examination, that there were numerous micrococci. This produced an inflammation entirely analogous to erysipelas in man. The œdematous fluid from the erysipelatous tissues of this rabbit was injected into a second, with the effect of producing a similar characteristic inflammation. In the affected parts of the skin of the second rabbit large quantities of micrococci were found.

Lukomsky has also found that an affection exactly similar to, if not identical with, cutaneous erysipelas, can be induced by the subcutaneous injection of fluids containing bacteria, or by the application of similar fluids to any raw surface; and, furthermore, that the contents of erysipelatous vesicles, *free from bacteria*, do not usually produce any morbid phenomena.

At the International Medical Congress in London, Dr. Koch showed photographs of micro-organisms which he had found at the periphery of erysipelatous tissue, and which he believed to be pathogenetic of erysipelas. These have since been proved, by a conclusive series of researches by Fehleisen, to be present in every case of erysipelas which he examined, to be capable of cultivation, and also of successful inoculation both in man and the lower animals. In every one of thirteen cases examined micrococci were found, which were identical with those figured by Koch in his photographs. Fehleisen succeeded in breeding the micrococcus to the fourteenth generation by cultivation of some small portions of skin in Koch's 'flesh-infusion peptongelatine,' and he states that, though he found organisms in connection with other pathological processes, they never behaved in the same manner as regards their cultivation. He next proceeded to a series of experiments on rabbits. In every instance, except one (where there was only a slight rise of temperature), the characteristic erysipelatous rash appeared at the end of about thirty-six to forty-eight hours, being preceded by a rise in temperature. The disease ran a definite course of about six to eight days, the redness spreading to the root of the ear and thence to the head and neck, unaccompanied by suppuration, and terminated in recovery. In every case micrococci were found in the lymphatics of the affected part.

In addition to the experiments on the lower animals, Fehleisen tested the virulence of these organisms by inoculations in the human subject, on the principle that an attack of erysipelas has often a beneficial effect in such diseases as cutaneous tumours, lupus, and even malignant growths. In the first case he inoculated the gluteal region of a woman suffering from multiple fibrosarcomatous tumours. On the evening of the same day there was a slight rise of temperature, and the following morning a rigor. On the morning of the fourth day there was a second rigor, and on the left buttock was found a sharply defined, slightly raised, reddened surface, having all the characteristics of erysipelas. The temperature was 105° F. The redness spread considerably during the day, and continued doing so until the seventh day, when the erysipelas occupied an area of a square foot. It then remained stationary for three days, and began to diminish in intensity. On the fifteenth day the temperature was normal. In six other cases Fehleisen inoculated the pure or cultivated micrococci, and erysipelas was induced in five of them, and ran a typical course to a favourable termination. As regards the therapeutic effects, in two cases only does any permanent benefit appear to have been derived. One, a case of lupus, was reported to have been almost entirely cured, and in another, an instance of cancer of the breast, which had already been operated on three times and presented several large tumours adherent to the skin, the erysipelas was followed by an entire disappearance of the cancerous growths which, up to the time of the report, had not reappeared.

Fehleisen also made some experiments on disinfection. He found that a three per cent. solution of carbolic acid, in forty-five seconds, rendered the organisms incapable of further cultivation, and the same effect was produced by a solution of corrosive sublimate in fifteen seconds. These researches appear to be quite conclusive, and should they be confirmed by other observers, the etiology of erysipelas may be considered to be fairly established, and the list of diseases due to a specific micro-organism is thus enriched by one.

B. *Exciting Causes.*—The poison of erysipelas being thus due to a materies morbi introduced from without, either through the atmosphere or by actual contagion, it is palpable that a wound must be a common *exciting* cause. Other exciting causes have been alleged to produce erysipelas, such as exposure to severe draught, a sudden chill, application of cold to the loins, and even fright. But these causes, even if they really exist, are by no means so potent as the presence of a wound. Some pathologists have believed that they have no existence. Billroth says: 'I am very doubtful whether erysipelas ever develops except from a wound, or from some pre-existing cause of inflammation.' Trousseau says: 'Observe with attention that the erysipelas described under the names of medical and non-traumatic has almost always a starting-point, which though it cannot, strictly speaking, be called a wound, is at least a lesion—a very slight lesion it may be in some cases.' Any wound of any size, in any stage of its progress, may be the exciting cause and the starting-point of erysipelas. Thus, a leech-bite, the sting of an insect, scarification of parts affected with œdema, the wound made in venesection, are all known as exciting causes of the disease. So, again, a perfectly recent incised wound, as in the removal of a sebaceous tumour of the scalp; or a contused and lacerated wound, as in a compound fracture of the leg; a healthy granulating sore, or an old sinus, may all be the starting-point of the disease. There seems, however, to be no doubt that erysipelas is more prone to attack a wound, when its secretions are retained and have become decomposed in the tissues.

C. *Predisposing Causes.*—These must be considered under two heads, either as affecting (1) the patient, or (2) his surroundings.

1. *In the patient himself.*—Believing that the efficient cause of erysipelas is due to micro-organisms, we know that the healthy blood is not favourable to their growth, and that the healthy body appears to be the most unfavourable habitation for them. Mr. Watson Cheyne and other observers have indeed asserted that in the

healthy state of the animal body there are no micro-organisms present among the tissues. Other pathologists again, though they consider it an accepted fact that these organisms may be present in the blood and tissues of healthy living animals, nevertheless assert that they are only to be found in very small numbers, and often only after the most elaborate preparation and careful examination. All, however, are agreed that the healthy living body is able to fence itself against the permeation of the blood and tissues by these organisms, unless, indeed, they be introduced in very large quantities. The investigations of Mr. Cheyne have an important bearing on this subject. He found that by lowering the system of an animal by the administration of phosphorus, he brought about a condition of system which permitted the introduction of micrococci in enormous quantities. The experiments of Professor Roshbach are also of importance in connection with this point. He found that by the injection into the blood of a chemical ferment, itself perfectly free from any organism, he produced such a change in the properties of the fluids of the body that bacteria were developed in immense numbers in the course of a very short time. The vegetable ferment used was papayotin, and having previously examined the blood of several rabbits to establish the absence of bacteria, he injected small quantities of a freshly-prepared solution of papayotin into a vein. Death of the animal took place in an hour or two, and the blood examined immediately after death exhibited, without exception, countless numbers of round and oval bacteria. In considering, therefore, the predisposing causes of erysipelas as regards the individual, we must believe that there are certain conditions of the blood in which bacteria become endowed with vitality and with reproductive powers.

The experiments of Mr. Cheyne, above alluded to, show that lowering the system will produce this result, and thus we find that a vitiated condition of the blood induced by habitual intemperance, or want of proper food, or by disease of the eliminatory organs, especially Bright's disease, or diabetes, or disease of the liver, are amongst the foremost predisposing causes of erysipelas, producing a condition of the system in which the poison appears to find a soil peculiarly favourable to its growth. A similar vitiated condition of the blood, rendering the patient prone to erysipelas, may be induced by over-exertion or long exposure to wet or cold, and in women by amenorrhœa. Mental emotions, and especially prolonged anxiety, no doubt through their general effect upon the system, may also be classed in the same group of predisposing causes. There are other causes, in which it becomes a question whether there is a special pathological condition of the blood, which renders it favourable to the introduction of bacteria. So great is the constitutional predisposition to erysipelas which some persons appear to possess, that the slightest cause produces an attack. And, again, there is the occurrence of a previous attack, which predisposes to a second. M. Verneuil records the case of a woman who had had seventy-nine attacks of erysipelas of the face; and some years ago a nurse in St. George's Hospital, who suffered from chronic eczema of the face, had an attack every spring and autumn. Again, the disease is said to be hereditary in some instances. Finally, erysipelas sometimes occurs in women at the menstrual period, and is stated to be more common in the female than the male. Age and occupation do not appear to have any influence on the disease.

2. *In the patient's surroundings.*—It is an incontestable fact that, under certain conditions, erysipelas is much more common and prone to attack wounds than under ordinary circumstances. Whether these conditions are atmospheric or not, with our present state of knowledge we are unable to say, though it has been asserted, but without any really reliable evidence, that the spring and autumn, east winds, a very moist atmosphere, and a low temperature, are conditions under which erysipelas is apt to occur as an epidemic. All that we can say at present is that the poison propagates and develops with greater vigour and energy under certain conditions or seasons than at others. More potent causes are bad ventilation and generally faulty hygienic conditions, and especially a vitiated atmosphere from the presence of decomposing vegetable and animal matters. It is well known that micro-organisms swarm in all putrefying solutions and mixtures of organic matter; the presence, therefore, of decomposing organic matter forms a hotbed for the production and growth of the special infective organisms of erysipelas, which become developed in such countless numbers as to overcome the resistance which the healthy living body appears to have to their reception, and they are admitted into the system either through an open wound, or by the respiratory passages or alimentary canal, or through the openings of the count-

less ducts, either cutaneous or mucous, and thus an attack of erysipelas is the result.

Pathology.—By an examination of the inflamed part, dilatation of the vessels of the cutis, with serous exudation into the surrounding tissues, can be anatomically demonstrated. Volkmann and others have shown that many white corpuscles are found collected around the vessels; and Hillier states that microscopic examination of the blood before death proves that many of the white corpuscles have undergone a process of degeneration, and become converted into highly refracting bodies. This change probably is only to be observed in the later period of the disease. It seems probable, from the manner in which the redness spreads in circumscribed patches, which are well defined, that the specific poison (micrococci) is introduced into the system by the lymphatic vessels; that it spreads along the superficial lymph-vessels of the skin, and more deeply through the subcutaneous vessels, giving rise to streaky redness and enlargement of the corresponding lymph-glands. This coincides with what has actually been demonstrated in numerous experiments. Lukomsky, for instance, found that when fluid, holding spores of fungi in suspension, was subcutaneously injected, it became widely distributed through the lymph canalicular system and lymphatics. Fehleisen, in the examination which he made of thirteen cases of erysipelas, found the micrococci in the superficial layer of the corium and subcutaneous tissue filling the lymphatics and lymph spaces, while the rest of the tissue showed cell-infiltration. He found no organisms in the blood-vessels, though other observers have stated that they have done so. When the subcutaneous tissue is involved in the disease (phlegmonous erysipelas) it is found, in the early stage, to be distended with serum, which soon becomes turbid, and, later on, is converted into shreddy sloughs, infiltrated with a puriform fluid. The post-mortem examination of cases of erysipelas presents nothing characteristic — merely those pathological changes which we are accustomed to associate with some altered condition of the blood, due to the absorption into it of some septic influence. Thus, the blood is fluid, thin, and uncoagulated, often black and pitchy, staining the lining membrane of the heart and its valves, and the large blood-vessels. The spleen is soft and diffluent, and the kidneys often congested. The lungs are also often highly congested; and, according to Busk, the smaller pulmonary vessels contain blocks of altered white corpuscles; and Bastian has described a similar condition in the vessels of the brain.

Symptoms and Diagnosis.—As a rule, erysipelas is preceded by considerable constitutional disturbance, sometimes of a very severe character, which ushers in the attack. At other times the amount of constitutional disturbance is very slight, so that it escapes the patient's notice, and thus the appearance of the local mischief is the first thing which attracts attention, and therefore it has been supposed that the disease may occur without any general symptoms. The severity of the premonitory fever is no indication, however, of the amount of local inflammation which is to follow. In some cases, where the early constitutional disturbance has been so slight as almost to pass unnoticed, the subsequent disease has proved to be of the most severe nature, and to be accompanied by a fever of the most marked and asthenic type; and in other cases where the premonitory fever has been severe, the following inflammation has been slight, and has terminated in resolution in the course of a few days. The disease is ushered in with a feeling of malaise, and general disinclination on the part of the patient to go about his ordinary occupations. There is a general chilliness, sometimes, though seldom, amounting to a distinct rigor, with headache and nausea, occasional vomiting and sense of oppression, and even pain in the precordial region.

The advent of these symptoms is generally sudden, and is marked by a rapid rise in the temperature, so that the chart will exhibit an increase of 4° or 5° between the morning and evening registrations. The skin is hot and dry, and the tongue coated with a creamy fur. In addition to these symptoms, occasionally a severe attack of epistaxis or, in children, convulsions, will usher in the disease. These general symptoms are followed usually, on the second or third day, by the appearance of the local inflammation; there does not appear to be any definite time for the characteristic redness to show itself; it may be within twenty-four hours of the first rise of temperature, or it may be delayed till the fifth or sixth day. Sometimes swelling and tenderness of the lymphatic glands in the neighbourhood of the wound, if there be one, precedes the appearance of any redness of the skin, and this becomes an important indication of the advent of an attack of erysipelas. That is to say, as has been pointed out by Frank, Busk, and others, a sudden rise in temperature and general febrile disturbance, attended by pain and swelling of the lymphatic glands in any region of the body, are very often indicative of an attack of erysipelas.

After the appearance of the local symptoms the fever rapidly assumes a marked asthenic type. The pulse is quick and weak, becoming weaker as the disease progresses, though its frequency is maintained. By Nunneley, Hinckes-Bird, and Campbell de Morgan it has been asserted that if the pulse rises in frequency after the sixth or seventh day it is a bad sign, betokening a fatal termination. The statement, however, appears to require further corroboration, and certainly must not be looked upon as universally true. The temperature remains high during the whole of the time the local inflammation is extending, ranging between 102° and 105° F., or even slightly higher, every fresh access of inflammation being marked by a rise in the temperature. As soon as the redness ceases to extend the temperature falls, oftentimes very rapidly, so that it frequently becomes normal, or almost normal, some time before the tongue has cleaned and the pulse dropped to its ordinary standard. The tongue, which during the premonitory fever is generally coated with a creamy fur, speedily becomes brown and dry. The bowels are generally constipated, and the motions dark and offensive. Towards the termination of the case, when the disease is subsiding, an attack of diarrhœa not infrequently sets in. This, however, may be present from the first, and is sometimes attended by a yellowish or jaundiced tingeing of the skin—a variety of the disease to which the older writers were wont to apply the term of 'bilious erysipelas.' The urine is generally scanty, loaded with lithates, and very constantly contains a trace of albumen. When the disease is subsiding it may contain a large quantity of albumen, with epithelium from the renal tubules, due to a temporary congestion of the kidneys. In severe cases of the disease, especially where it attacks the head, the patient may suffer from delirium of a low, muttering type. This is due to the condition of the blood, not to any extension of the inflammation to the membranes of the brain. Dr. Bastian suggests that the delirium may depend upon the plugging of the small arteries and capillaries of the brain with embolic masses of white blood-corpuscles—conditions which he found to exist in the case of a man who died from erysipelas with delirium and stupor.

Erysipelas has been defined as a spreading inflammation of the skin, or of the cellular tissue beneath it. It is therefore convenient to divide it for the purposes of description into (1) simple cutaneous erysipelas, affecting only the skin, the subcutaneous tissue being only very slightly, or not at all, affected; and (2) phlegmonous or cellulo-cutaneous erysipelas, in which the inflammation affects, not only the skin, but the cellular and adipose tissues beneath, and often runs on to suppuration. A third variety is sometimes added to these—the cellular erysipelas, or diffuse cellulitis of Nunneley, where the inflammation is confined to the subcutaneous tissue, the skin remaining unaffected, or where the inflammation attacks cellular tissue in places where there is no skin, as in the pelvic cellular tissue, or the areolar tissue between muscles or beneath fascia. The name is often confounded with phlegmonous erysipelas, which should be avoided, as leading to confusion. It is considered under CELLULITIS.

I. *Simple Cutaneous Erysipelas.*—The local inflammation usually starts from a wound or abrasion. It may, however, commence at the point of junction of the mucocutaneous surfaces, a not unusual situation being the inner canthus of the eyelid, whence it spreads over the bridge of the nose. The angle of the mouth, the external auditory meatus, and the margin of the anus are also situations at which the disease occasionally commences. Lastly, it may commence on the mucous surfaces, notably those of the pharynx and nasal fossæ, and spread outwards to the skin. This is not a form of metastasis, as was formerly supposed, but a true spreading of the disease from the one surface to the other, the inflammatory redness, when the pharynx is the part first affected, spreading to the nasal mucous membrane and first appearing on the cutaneous surface at the orifices of the nostrils, and thence spreading to the nose, cheeks, eyelids, and other parts of the face.

At the outset the skin, as a rule, becomes of a bright red or rose-tint. The colour, however, may vary: sometimes there is a decided yellowish tinge, sometimes it is a deep livid red. The redness disappears on pressure, but immediately returns upon the pressure being removed. The affected part is also swollen and slightly œdematous, pitting on pressure. The limits of the inflammation are sharply defined, the redness not gradually fading away into the natural colour of the skin, but presenting an abrupt, though irregular, outline. On passing the finger lightly over from the margin of the inflamed tissue to the normal skin, the swollen condition of the former will be plainly noticed by the marked elevation which will be felt at the line of junction. In the simple cutaneous erysipelas the œdema, as a rule, is not great, unless in situations where the cellular tissue is very loose and lax, as in the eyelids and scrotum; here there is generally very considerable œdema, which often runs on to suppuration; otherwise the formation of pus does not usually result from this form of erysipelas. In many cases the inflamed part is covered over with vesicles or even blebs. These at first contain clear serum, which in the progress of the disease becomes semipurulent. They burst, and, drying, form scabs on the surface, which, however, separate without ulceration. Occasionally these bullæ will be found to contain reddish or purplish contents, from infiltration with blood-pigments. This is always an unfavourable sign, as indicating a weakened condition of the system.

At first there is stiffness complained of in the part, accompanied by tingling and itching; this is succeeded by a burning sensation and a feeling of tension. Occasionally we find that there is an entire absence of pain, but there is always more or less tenderness on pressure; sometimes there is a very exalted sensibility of the nerves, so that the application of even a piece of lint is distressing to the patient, and the slightest touch elicits an expression of pain. The redness spreads widely—in fact, it may spread all over the body, but always maintains the same defined margin; usually it spreads more in one direction than another, and especially along the course of the lymphatic vessels. The manner in which it spreads is worthy of observation. On carefully examining the margin of a spreading cutaneous erysipelas, there will often be noted to be circumscribed, reddened, and somewhat rounded patches, which spread until they become merged into the already diseased parts. This confirms the opinion that the poison travels principally by the lymphatic system, and that these isolated patches are certain lymph-vascular districts which become primarily affected, and thence merge into the general disease.

The characteristic tint will usually be found to be most marked at the borders of the spreading inflammation, the redness having a tendency to fade in the centre as it spreads at the circumference. The inflammation, though principally affecting the skin, is not confined to it, but the subcutaneous tissue is more or less involved; and where this is loose or lax, as in the face, very considerable swelling takes place, obliterating the features and giving to the countenance a bloated and hideous expression.

The duration of erysipelas is very uncertain. It usually lasts from two to ten days, but may be prolonged to the end of the third week, or even, in some rare cases, for a longer period, and nevertheless terminate in recovery. Coincidently with a sudden fall of temperature the redness begins to disappear and desquamation takes place, the epidermis peeling off, partly as a branny powder and partly in scales. With the disappearance of the redness the swelling usually subsides; should it persist, suppuration may be expected. When the disease attacks the scalp the whole of the hair may fall off, but speedily grows again. Even after a mild attack the patient's strength is much reduced, and relapses are by no means uncommon.

Although œdema is almost always more or less present in erysipelas, so as to produce a certain amount of pitting, yet in some states of the system the inflamed tissues become loaded with serum, causing them to be excessively œdematous, and giving rise to a condition which has by some been regarded as a distinct variety, and to which has been given the name of 'œdematous erysipelas.' This condition occurs in those who are debilitated by previous illness or whose constitutions have been broken down by visceral disease. The inflamed parts are much swollen, the redness, instead of being bright and rose-coloured, is of a dusky hue, and there is a greater tendency to run into gangrene. The condition is a serious one, not so much on account of the local mischief as on account of the constitutional state which has given rise to it.

Erysipelas has a tendency occasionally to assume an erratic form—that is to say, it will subside in one part of the body and break out in another. Closely allied to this is the 'metastatic' erysipelas of some authors, where the inflammation suddenly disappears from the surface of the body and simultaneously attacks some internal organ. This condition, however, is extremely rare.

Simple cutaneous erysipelas is not often fatal unless complicated with some visceral mischief, or when it attacks the head and neck. Instances of the former—where, for instance, a patient suffering from granular degeneration of the kidney is attacked by erysipelas—are not uncommonly fatal; and, when the disease attacks the head and neck, fatal results may ensue either from congestion of the brain from the mechanical impediment to the return of the venous blood, or from the disease extending to the pharynx and air-passages and producing œdema glottidis, or from the spread of the disease to the interior of the chest.

After the eruption of erysipelas has become fully developed it is scarcely possible to mistake the disease. Prior to this, when in the progress of a case, either with or without any apparent change in the wound, there is a sudden rise of temperature with other febrile symptoms, attended with pain and swelling of the lymphatic glands in the neighbourhood, the advent of an attack of erysipelas may be suspected but cannot perhaps be confidently predicted. The appearance of the rosy-red sharply-defined blush establishes at once the diagnosis. We may hesitate for a moment as to whether it is a simple inflammation of the subcutaneous tissue or a lymphangitis; but the absence of the sharply-defined border in the one case and the course of the disease in the other will speedily determine the point.

II. *Phlegmonous Erysipelas.*—This form of erysipelas usually occurs in patients of broken-down constitutions, either the result of habitual intemperance or from some disease of the liver or kidney. It differs from the preceding variety in the degree of inflammation, in the depth to which the tissues are involved, and principally in the fact that it almost always runs on into suppuration and sloughing. For, whereas in the cutaneous form of erysipelas it has been shown that suppuration, except in places where the subcutaneous tissue is very loose and lax, rarely or never takes place, and, when it does, is not accompanied by sloughing; in the phlegmonous variety the involved cellular tissue for the most part falls into a condition of extensive suppuration and gangrene. The constitutional symptoms which usher in and accompany the inflammation are more severe. The invasion is marked by more pronounced general disturbance, a rigor being a frequent precursor of the local inflammation; and the accompanying fever, at first, of an active inflammatory character, often suddenly becomes asthenic. The temperature is high from the first, the thermometer often registering 103° to 106° F. The pulse, full and bounding at the commencement, soon loses power, becomes weak and quick, and, especially in fatal cases, irregular and intermittent. The tongue is dry and brown, and the teeth become covered with sordes. Diarrhœa often sets in from the first and the motions are offensive. In the latter stages delirium, of a low, muttering character, and subsultus are present, the patient often lying in a semi-unconscious, wandering condition, from which he can be temporarily aroused, but into which he again speedily relapses.

The constitution often gradually gives way from the exhausting influences of the disease, and death supervenes; or a fatal issue may occur from some complication, as pneumonia or pleurisy. Should the patient survive the stage of sloughing, pyæmia or septicæmia not uncommonly supervenes; or hectic, with diarrhœa, may carry him off.

Phlegmonous erysipelas is generally the result of wounds penetrating the subcutaneous tissue. It is therefore not uncommon after scalp wounds involving the aponeurosis of the occipito-frontalis muscle, or in compound fractures of the extremities. It may, however, occur without any wound or abrasion. From the commencement there is marked œdema, so that the swelling is great and pits on pressure. The part is red, but the redness is of a more dusky hue than in the cutaneous form, and does not present the same well-defined abrupt margin. It is often covered with large vesicles or blebs containing sero-purulent fluid, sometimes with a sanious tinge. After a time the tissues become hard and brawny, and no longer pit on pressure; the redness becomes deeper. Pain of a severe burning and tensive character is complained of. The inflammation spreads, so that in a day or two the greater part of a limb may be involved. The redness becomes deeper and deeper, and purple patches appear. About the fifth or sixth day from the commencement of the inflammation an arrest of the symptoms appears to take place; the inflamed parts become soft and boggy, and pitting again takes place on pressure. If an incision be now made into the affected part the areolar tissue will be found to be loaded with an opaque fluid, giving a gelatinous appearance to the sides of the incision. This fluid speedily breaks down and becomes puriform, and the cellular tissue becomes the seat of suppuration and death. The purple patches on the surface become livid and break down. The pus which escapes is fetid. From time to time large masses of gangrenous tissue protrude from the openings and are discharged, or can be drawn out by the surgeon. The skin around, being deprived of its proper blood-supply, perishes and gradually sloughs away. And thus, in extreme cases, a whole limb may be denuded, fasciæ and muscles exposed, joints opened and destroyed, and bones deprived of their periosteum and thrown into a condition of necrosis. If the patient survive, there will be tedious cicatrization of the deep cavities which have been left, often leading to such contraction and deformity as to render the limb permanently disabled.

As a rule there is no difficulty in distinguishing the phlegmonous from the cutaneous form of erysipelas, when the disease is fairly established. It must be noted, however, that the severer form of the disease occasionally presents at first the same appearances as the simpler form, and it is not until the greater swelling, with the brawny hardness, has appeared, that a definite diagnosis can be arrived at. These signs, with the absence of the well-defined margin to the redness, at once establish the formidable nature of the disease. Phlegmonous erysipelas may be mistaken for diseases with which it is frequently associated, as phlebitis and inflamed absorbents. In the former, however, as a rule, the swelling is confined to the course of the vessel, and the hardened vein can be traced; and even if this is not so, and the swelling is more diffused, still the amount of redness, which is much less in phlebitis than in phlegmonous erysipelas, is indicative of the nature of the disease. From inflamed absorbents, the condition of the glands, exquisitely tender and speedily running into suppuration, and the streaky character of the redness are the principal points which must be relied upon in coming to a correct diagnosis.

Erysipelas occasionally attacks the mucous membrane of the pharynx. It may occur here either by spreading from the face, or it may commence as a primary affection in this part, and extend outwards through the nasal fossæ, and appear on the face at the orifices of the nostrils. When it begins as a primary affection in the pharynx, there is much pain in the throat, a sudden rise of temperature, and considerable pyrexia, with enlarged glands about the angle of the jaw. There is vivid redness of the soft palate, fauces, and back of the pharynx, with considerable swelling. There is often huskiness or complete loss of voice. It may be mistaken for ordinary catarrhal sore-throat, but in these cases the symptoms are not usually so severe, the pain is less, the redness not so vivid, and the swelling not so great. The appearance of the characteristic redness at the orifice of the nostrils establishes the diagnosis. The danger of this affection arises from its tendency to spread downwards to the mucous and submucous tissues of the larynx, constituting *œdema laryngis*, and speedily threatening life from suffocation.

Erysipelas also sometimes attacks newborn infants (*Erysipelas neonatorum*). When it occurs during the first fifteen or twenty days of life, it is almost inevitably fatal. It generally begins to show itself about the pubes or umbilicus and rapidly spreads, accompanied by extreme prostration, terminating the life of the child in from five to seven days. Trousseau regards it as a *puerperal* erysipelas, and considers that the same epidemic influence affects mothers and their offspring. He says it seldom occurs except during epidemics of puerperal fever. There can be little doubt that puerperal fever is but an internal manifestation of erysipelas. The instances which have been recorded of the one disease exciting the other are too numerous to permit of any doubt of the intimate connection between the two.

Erysipelatous inflammation of serous membranes, especially of the peritoneum after operations for hernia and other wounds, is not infrequently met with. In these cases, after death the peritoneum is found to be injected, opaque, and covered with patches of greyish lymph, and the cavity contains a quantity of fluid mixed with shreds of lymph. This fluid is of an exceedingly virulent nature, inoculation of it producing the most serious and even fatal consequences.

Treatment.—The treatment of erysipelas naturally resolves itself into *general* and *local*. With regard to the former there can be no doubt that fresh air is essential, and that the first and strictest attention should be paid to the ventilation; at the same time, especially if the head and face be the part attacked, care must be taken that the patient be not exposed to any draught. All curtains and hangings about the bed should be removed, and every means taken to prevent stagnation of air around the patient.

It is essential, in all cases of erysipelas, that the bowels should first of all be cleared out by a brisk mercurial purge. Even though diarrhœa be present from the commencement, it is wiser not to omit this precaution. The diarrhœa may, and often does, arise from a loaded state of the bowels, the motions being dark and offensive, and a free purgation will not only materially improve the patient's condition, but will also often prove the best means of checking the diarrhœa, and will enable the patient to take the necessary food and stimulants with greater advantage. It must be borne in mind that erysipelas is a disease accompanied by fever; this fever having a tendency either from the first to assume an asthenic type, or, at all events, speedily to fall into this condition. The medicinal treatment should, therefore, consist in the exhibition of salines and tonics. If there be much thirst and dryness of the tongue, the salines may be given in an effervescing form; and of all tonics the one which, in the writer's experience, appears to be the most beneficial is bark, which may be combined with the salines in the form of the compound tincture. The addition of ammonia, as a diffusible stimulant, appears also to produce a good result. The medicine should be administered in frequent doses, and if there is any tendency to constipation, this condition must be corrected by an occasional purgative. If, on the other hand, diarrhœa is present, small doses of grey powder and carbonate of soda, once or twice a day, will generally be found to correct it.

The diet must be entirely fluid, consisting of beef-tea or mutton-broth and milk, and must be given in such quantities as the patient can digest. Care must be taken not to overload the stomach. In erysipelas there is always more or less derangement of the digestive organs; the stomach often rejects large quantities of food. The sensations of the patient must be our guide in this matter; if there is a loathing for food and a tendency to sickness, it must be withheld or only given in very small quantities. Stimulants are almost always required in erysipelas, sometimes even from the commencement, and occasionally in large quantities. The amount must be regulated by the pulse. If there be any tendency to flagging, and especially if it rises in frequency after the sixth or seventh day, they must be given with an unsparing hand. If, on the contrary, they produce dryness of the skin, flushing of the face, and restlessness, they have been given in too large quantities, and their amount must be reduced. The amount required will no doubt be influenced by the previous habits of the patient.

Only two drugs have any especial reputation in the treatment of erysipelas. Perchloride of iron was first recommended, in 1851, by Dr. Hamilton Bell, as a specific in erysipelas if given in large and repeated doses. He states that in it 'we possess a certain and unfailing remedy.' The experience of surgeons on this point certainly differs; for while some have found the greatest benefit from its administration, believing that it cuts short the disease, others have found it to be altogether inert, or at all events apparently producing no effect on the ordinary course of the erysipelas. In the hands of the writer it has certainly failed, though he has given it in drachm doses every two hours. The only cases in which it has appeared to have any beneficial influence have been slight cases, where there has been no derangement of the digestive system, and a clean, or comparatively clean, tongue. The other remedy is aconite, which is stated by Dr. Ringer to cut short the attack if given directly the temperature begins to rise. He recommends that it should be given in minim or half-minim doses every quarter of an hour for one or two hours, and then hourly until the temperature falls and the skin becomes moist. Its administration must be carefully watched. Salicylic acid and its compounds have been employed of late years in the treatment of erysipelas, and appear to have been useful in reducing the temperature, but do not seem to exert any specific influence on the disease.

Local Treatment.—The number of local applications which have been recommended in the treatment of erysipelas is very large, many being employed in the belief that anything which would check the local action would have a tendency to remove the general disease. Thus Neudörfer recommends the injection of a two per cent. solution of carbolic acid into the neighbourhood of the inflamed part. Professor Petersen, of Kiel, states that he has thrice arrested the progress of erysipelas by injecting a concentrated solution of salicylic acid around the diseased part. Wilde recommends the injection of a solution of sulpho-carbolate of soda (one part in twelve). He states that, in five cases, on the evening of the first day the temperature did not rise. On the second day there was a fall and the redness had begun to disappear, and on the third day œdema alone remained. With a similar object of removing the general disease by checking the local action, astringent applications have been frequently recommended. The sulphate of iron, in the form of a lotion consisting of a drachm to a pint of water, or of an ointment, half a drachm to an ounce of lard; a 30 per cent. mixture of nitrate of silver and perchloride of iron (gr. xx. ad ʒj.) in solution, have all been said to tend to shorten the disease. Collodion painted over the surface has also been recommended, and is stated to act as an astringent, diminishing and unloading the vessels. Broca recommended painting collodion around the margin of the inflamed tissue and over a space of at least six to eight centimetres in breath beyond it, and believed that in this way the disease might be arrested. Another favourite plan, which was highly recommended some years ago, but appears to be for the most part useless, is to apply a ring of lunar caustic to the healthy tissue some few lines from the inflamed part. This is said to arrest the progress of the disease when it reaches the ring. The American surgeons recommend very strongly the local application of the compound solution of bromine to an erysipelatous part. The solution is applied on lint and covered with oiled silk, and they state that, in from twelve to twenty-four hours after the commencement of the treatment, the erysipelas begins to subside. Other remedies, such as tincture of iodine, sulphurous acid in glycerine, boracic acid and glycerine, and creosote, have also been employed with the same object.

Various applications, whose aim it is to exclude air, have also had their advocates. Barwell recommends covering the surface of the inflamed part with a coating of ordinary white-lead paint, and states that the advantages derived from this plan of treatment are due to the exclusion of air. The dusting of starch and flour over the surface in a thick layer is a popular and favourite remedy, but is objectionable because it soon dries and cakes and acts as an irritant. Plain olive oil, or carbolic oil, are also remedies which have been frequently advocated. Sedative applications have also been recommended and are occasionally useful, especially when much pain is complained of. Of these, belladonna and poppy fomentations are the ones most frequently used. The belladonna may be employed either in the form of an ointment or of a paint consisting of equal parts of the extract and glycerine.

Whatever the application to the inflamed part, there are certain indications which should not be neglected. Cold must be carefully avoided; the part should be kept warm, and, as far as possible, of an equable temperature. Perhaps there is no better plan than the application of a thick layer of cotton wool, over which has been spread an ointment consisting of half a drachm of sulphate of iron to an ounce of lard or vaseline; or an ointment formed of equal parts of Ung. plumbi and Ung. calaminæ. Poultices should be avoided, and, as a rule, dry warmth will be found preferable to moist applications. Finally, strict attention should be paid to position, the inflamed part being elevated in order to relieve congestion, and this alone will often afford marked relief to the symptoms.

The local and general treatment of phlegmonous erysipelas is, in the main, the same as that of the cutaneous form of the disease as regards the earlier stages, except that support and stimulants require to be more freely given, and warm moist applications appear to be more suited to this class of cases. Later on, incisions will probably be necessary. As soon as there are signs of tension and the skin becomes brawny, they should at once be made. They should be each two or three inches in length, and carried down into the infiltrated tissues, and should embrace the whole extent of the tense parts. In the slighter forms of phlegmonous erysipelas the disease may terminate in resolution, under proper treatment, without incisions; it is not necessary therefore always to resort to them in the first instance, and if, under the influence of elevation of the part, warm fomentation, and a free purge, the skin begins to recover a paler hue, and presents a somewhat wrinkled appearance, they may be dispensed with altogether. T. Pickering Pick.

ERYTHEMA is the term used to express the clinical aspect of congestion of the skin, and may be defined as 'redness of the skin which disappears for a moment upon pressure.' Much confusion has arisen from its being employed indiscriminately for the symptom of redness, irrespective of the cause, and also for two groups of diseases—one the result of hyperæmia only, of which erythema simplex is the type, the other due to actual inflammation, represented by erythema exudativum. At the same time it must always be borne in mind that the line between hyperæmia and inflammation is a narrow one, and many of the affections which are here classed under hyperæmia are only entitled to be so in the majority of cases, while in others the process goes on to exudation. The distinction, therefore, is often one of clinical convenience rather than of pathological accuracy.

Group I.: Erythema Hyperæmicum.—In this class swelling is absent or insignificant in the congested areas, and the tint of redness varies from the brightest red to a rosy or purple hue, according to the predominance of arterial or venous hyperæmia. There are two groups—I. Those of local distribution, due to external irritation; II. those of more or less general distribution, due to internal causes.

Sub-Group I. includes *E. Simplex, E. Pernio, E. Intertrigo, E. Læve, E. Paratrimma.*

Erythema Simplex is the congestive redness due to external irritation of moderate intensity. The size and tint of the red patches vary according to the irritant, the individual susceptibility, and the activity of the circulation in the affected area. The symptoms are generally a sense of heat, and perhaps tenderness and itching of varying intensity.

Etiology.—The causes are very numerous, and may be arranged under the heads of friction, heat, cold, and various irritants—animal, vegetable, and chemical.

Erythema Pernio (*Syn.*: Pernio, Chilblains) is the well-known congestive redness, the consequence of cold, which attacks the extremities, especially the heel and borders of the feet, in young persons and those with feeble circulation. It is accompanied by extreme itching whenever the limb becomes warm, and is often very tender. If neglected or exposed to friction, the congestive stage is soon passed, and vesication, superficial ulceration, and even a small slough, may be produced. The treatment consists in adopting every measure to keep up an active circulation in the limb; warm socks, stout lace-boots, and active exercise are the best means both for prevention and cure, unless there is ulceration. If seen in the early stage, calamine lotion (the formula is given under E. exudativum) applied three or four times a day and allowed to dry on, or tincture of iodine, should be painted on (if for the hands, it may be decolourised by Liq. ammoniæ); and if the chilblain is broken, the Ung. calaminæ (B.P.), or boracic lint and oiled silk, may be used, and the limb should be wrapped up in cotton wool. *See* Chilblains.

Erythema Intertrigo is produced in fat persons and infants by the friction and moisture of two adjacent surfaces, and occurs chiefly in the neck, under the breasts in women, and at the groins in adults; while in infants it occurs sometimes in the neck, but more often on the buttocks, from wet napkins caused by urine or fæces, especially when diarrhœa exists. The lesion is at first merely redness of the skin, but very soon the red surface is covered with a muciform discharge, which differs from that of eczema inasmuch as while it stains it does not stiffen linen. This stage is, however, termed by some 'eczema intertrigo.'

Diagnosis.—The diagnosis from eczema is not very important practically, and consists in the circumstances and position in which the affection occurs and the difference in the quality of the discharge. In infants it is of more consequence to distinguish between intertrigo and the erythema of congenital syphilis. Intertrigo is limited to the buttocks and genital region, while the syphilide extends much further down, even to the heel, and there are very often mucous tubercles at the anus or some ulceration, and some other specific symptoms would almost surely be present. Syphilitic infants are also more liable to ordinary intertrigo. *See* Congenital Syphilis.

Treatment.—This consists in carefully cleansing the parts and applying a dusting powder, such as oxide of zinc one part and starch or kaolin three parts, and placing a piece of lint between the adjacent surfaces. In infants wet napkins should always be removed instantly, and the parts washed with Castile soap, carefully dried, and dusted over with a powder such as above indicated; or where there is diarrhœa, boracic acid, gr. xx., to vaseline alb. ℥j. is often preferable, as the grease protects the buttocks from the moisture. Diarrhœa or other defects, whether in diet or general health, should receive special attention.

Erythema Læve is the term applied to the redness which often occurs in œdematous limbs, especially in the legs.

Erythema Paratrimma is the congestive redness over a bony prominence that precedes a bed-sore. Neither this nor the preceding term are much used at the present day.

Sub-Group II. includes *E. Roseola. E. Scarlatiniforme, and E. Fugax.*

Erythema Roseola, or 'roseola' as it is often called, comprehends a certain class of erythemas which are not of so bright a hue as the others—viz., rosy red. They may be idiopathic or symptomatic.

Idiopathic Erythema Roseola occurs mainly in infants and young children, from disorders of the alimentary canal. There is often some constitutional disturbance, a transitory elevation of temperature, sometimes amounting to 2° or 3° F., and perhaps some redness, without swelling, of the palate and fauces, but no catarrhal symptoms. After a short but variable period the eruption appears; it may be general or affect only a single region; it is very variable in size and shape—in patches the size of the end of the finger, or faintly papular, in rings or gyrate figures; it may come at one place and go at another, and so last several days. Willan gave separate names to these phases of eruption, such as R. infantilis, æstivalis, autumnalis, annulata, but they are entirely superfluous and now almost obsolete. The eruption may occur in adults of both sexes, and the cause is often quite obscure.

Symptomatic Erythema Roseola is applied to those eruptions which precede or accompany the onset of the more characteristic eruption of vaccinia, variola, and syphilis, or which is sometimes seen in cholera, diphtheria, and miliaria (R. febrilis). It does not require a separate description, as it is only a part of these diseases.

Diagnosis.—This is the most important point in these affections, as the eruption may be mistaken for measles, rötheln, or scarlet fever; but the disease is not contagious, and not a part of an epidemic influence. There are none of the special prodromal symptoms of the exanthemata, such as catarrh, cynanche, &c., nor does the eruption appear at a definite time from the onset of symptoms, nor always begin in a special region; the febrile symptoms are more transitory and not in proportion to the eruption; the eruption is not concentric like measles, nor is it punctiform like scarlet fever, and it is irregular in form and arrangement. The diagnosis from rötheln is sometimes difficult, as there, too, the febrile symptoms are transitory, and there are no reliable differences in the eruption for all cases. But the contagious nature of rötheln, and the other criteria already mentioned, will assist in forming a correct conclusion; still, in a doubtful case, it is always best to act as if the disease were infectious.

Treatment.—As idiopathic roseola always gets well of itself in a few days, simple measures, such as a mild saline aperient, a bland liquid diet, protection from alternations of temperature, and the removal, if possible, of all sources of peripheral irritation, such as may arise from dentition, worms, &c., will be sufficient.

Erythema Scarlatiniforme is closely allied to E. roseola. The rash, as its name indicates, is almost exactly like the punctiform eruption of scarlatina, but is often defined at the edge with an interval of white skin between the erythematous areas. There are generally transitory febrile symptoms, such as a temperature of 101°—seldom more—and the rash subsides in from two to six days, and is often followed by copious desquamation.

Etiology.—The eruption may be of septicæmic origin. It is seen not infrequently after surgical wounds, though less often since antiseptic precautions have been generally adopted; where pus is shut up in a cavity—e.g. abscesses, tubercular peritonitis, empyema, in puerperal women; and preceding, or in the course of, enteric fever. A precisely similar rash sometimes follows the use of certain drugs, such as copaiba, quinine, belladonna, and salicylic acid. In these cases the eruption is probably due to irritation of the alimentary canal acting reflexly on the vaso-motor centre.

The rash itself requires no separate treatment.

Erythema Fugax is more closely allied to urticaria than to the other erythemata, and is characterised by transitory patchy redness upon the face and trunk, occurs chiefly in the young, and disappears after lasting a few minutes or hours. In children it is frequently due to irritating ingesta, worms, or other causes of irritation of the alimentary canal; it may also follow exposure to alternations of temperature or mental emotion, while frequently the cause cannot be traced. The treatment would be that for urticaria.

GROUP II.: ERYTHEMA EXUDATIVUM.

Definition.—Acute inflammatory diseases characterised by symmetrical, raised lesions of some deep shade of red, extremely diverse in size, shape, and degree of elevation.

This group includes E. multiforme, E. or Herpes iris, and E. nodosum.

Erythema Multiforme, as its name suggests, is very variable in its aspect, chiefly from differences in the size and shape and aggregation of the lesions, but also from the occasional formation of vesicles or bullæ upon, or the occurrence of hæmorrhage into, the primary lesion.

Etiology.—This is often obscure in the most important particulars; it may occur in both sexes and at any age, but is most common in the young. It is most frequently seen in the spring and autumn, but is not limited to those seasons, and recurrences often happen at the same time of the year in the same individual. Rheumatism appears to be a predisposing cause, and certainly previous attacks lead to others. Sudden alternations of temperature, especially when over-heated, are probably the most common agents in determining the onset, and the writer has known exposure to the sun and brine-laden winds to act as a certain excitant in individual instances. Irritation of the urethra is another cause, so that it may occur in the course of gonorrhœa. It is seen sometimes in association with endocarditis or acute rheumatism or simple synovitis, and is then probably a consequence of some toxic element in the blood. In erythema or herpes iris the same general statement may be made, except that it is not so intimately related to rheumatism, and that occasionally errors in diet or, in rare instances, a local irritant, such as mercurial inunction, has determined an outbreak. Erythema nodosum commonly occurs in children and young adults, and for the rest, what is known of its etiology corresponds with E. multiforme.

Symptoms.—The onset of the eruption is usually preceded and accompanied by constitutional symptoms, sometimes of considerable severity, such as malaise, pain in the head, back, and limbs, especially the joints, leading sometimes to the suspicion of acute rheumatism; the temperature is raised to 100° or even to 104° F., with a corresponding pulse-rate, and perhaps gastric disturbance; on the other hand, in some cases these symptoms are absent, or so slight as to be scarcely appreciable. After a varying interval of from one to four days the eruption appears, usually upon the backs of the hands and feet, and subsequently in crops upon the face, trunk, and rest of the limbs, most abundantly round the most painful joints.

The extent of distribution is very variable, sometimes being pretty general, including even the mucous membranes; at others limited to one or more regions, but it is seldom absent from the back of the hands whatever other regions may be affected. The symmetry is not absolute, the eruption being sometimes later and less developed on one side. It commences in the form of deep red papules varying in size from a pin's head to a small split pea, slightly raised and obtusely conical or convex (E. papulatum). These may coalesce into large plateaux, but when discrete speedily enlarge to the size of tubercles (E. tuberculatum or tuberosum), and continuing to develop peripherally, the centre becomes depressed, of a purplish hue, and a ring is formed (E. circinatum, or annulare); still enlarging, and meeting adjoining lesions, the ring is broken and gyrate curves are produced (E. gyratum).

Closely allied to this is E. marginatum, which, beginning as a flat disc one quarter or half an inch in diameter, rapidly enlarges at the periphery, subsiding *pari passu* at the older part, and joining with similar lesions, the raised border rolls onwards, as it were, and traverses the circumference of a whole limb, or a large part of the trunk, leaving distinct, fawn-coloured pigmentation to mark its course. Whilst some of these changes are going on in the part first attacked, crops of papules may be coming out elsewhere and passing through the same phases as the older ones; thus it sometimes occurs that many of the variations in the appearance above described are seen simultaneously on different parts of the body.

As accidental features, vesicles or bullæ may form on the erythematous lesions (E. bullosum), or hæmorrhages may occur into them, and the affected extremities may be generally œdematous and livid. It must not, however, be supposed that the above description applies to all cases; generally the eruption stops short at one or other of the phases, and often the same kind of eruption occurs in each succeeding attack, and in these instances the separate names mentioned justify to some extent their existence. Erythema papulatum is the most, and E. marginatum the least common of these forms.

Herpes Iris.—This eruption is conveniently considered as a separate variety, because the vesicular eruption generally occurs independently of the other forms; but it is very closely allied to the annular variety of E. multiforme, which may present similar concentric rings of various colours, and is then called E. iris.

Symptoms.—The eruption is preceded by a stinging and itching sensation, usually at night, then a small, red, slightly raised, flat papule appears, and in about twelve hours is covered with a vesicle, surrounded by a narrow red line; the lesion spreads at the periphery, the centre first flattening and then becoming depressed. This is now of a violet hue; outside is a white raised border, evidently containing some fluid, and beyond this is a narrow red zone of hyperæmia. The patch may be from the size of a threepenny-piece up to that of a shilling, reaching its full development in about a week, and in mild cases goes no farther; but after remaining for a few days longer, the fluid is absorbed, the disc flattens down, and leaves only a purplish stain behind. In more severe cases a central bulla may remain, and there may be several concentric white and pink zones, separated by violet zones. The bullæ vary in size from a millet-seed to a walnut, and the patches, by coalescence, may attain considerable dimensions.

The eruption is symmetrical, though it may appear upon one side before the other; it occurs most frequently upon the extremities, especially upon the backs of the hands and arms, but may come on the face, the mucous membranes of the mouth, tongue, and eye, and in rare instances is universal, and may then be associated with hæmaturia. In another form a bulla is seen surrounded by a ring of vesicles, round which there may be a second and even a third concentric ring of vesicles, with a zone of a purplish hue between the circles. This is the form that gave rise to the term Herpes iris, but it is much less common than the other kind, though essentially of the same nature. The eruption by the evolution of fresh lesions may last three or four weeks, seldom longer, but is almost sure to recur, often at the same period in the following year; and some people have three or four attacks a year.

Erythema Nodosum is rarely seen in adults, but is not uncommon in children. The skin-lesion is often preceded by slight febrile symptoms, articular pains, and digestive disturbance. The lesions come out by two or three at a time, but seldom exceed a dozen, and are oval, nodelike swellings, from a hazel-nut to an egg in size, occurring mostly upon the arms and legs, especially over the tibia and ulna, with the long axis in the length of the limb. They appear sometimes quite suddenly, are firm at first to the touch, but soon give a semi-fluctuating sensation to the finger; but they never suppurate, and are very painful and tender. They are at first of a purplish red, but as they disappear, go through the changing tints of a bruise. The disease runs its course in from two to four weeks, and does not recur in the same way as the other exudative erythemas.

Pathology.—There are strong grounds for considering these affections to be of central vaso-motor origin, while the immediate cause of the lesion is an exudation from the blood-vessels of serum and leucocytes, and in some cases there is rupture and extravasation of blood into the inflamed tissue. In a patch of E. tuberculatum, excised from the neck, the writer found the upper part of the rete broken up, and the space filled with cell-effusion, very dense in some parts, and looser in others, as if separated by fluid; although the effusion was for the most part limited to the rete and upper part of the corium, it sometimes extended sparsely to the bottom of the corium, especially along the hair-follicles and sweat-ducts. In some places there was slight thickening of the rete, and the palisade-cells were stained with blood-colouring matter. All the phenomena of inflammation were thus present.

In Herpes iris the only difference from E. annulare or iris is that sufficient fluid is effused to make its way through the rete, and elevate the horny layer into a vesicle.

The pathology of E. nodosum is disputed; probably it is of much the same character as the others; but it has been ascribed to lymphatic inflammation, and to inflammatory infarction following embolism in the cutaneous vessels. There can be no doubt that the exudation, though usually serous, is often hæmorrhagic.

Diagnosis.—In a typical case the multiform lesions, the acute course and the special features of the lesions, as above described, and their association with articular pains, would prevent error. It is when there is only a single phase of the disease present that mistakes may arise.

E. Papulatum, coming out on the back of the wrists and upper part of the face, and attended with febrile symptoms, may give rise to a suspicion of modified variola, especially if there happens to be vesiculation superadded. The pain in the back, if any, would not be so severe as in variola, vomiting would be absent, the eruption would not appear on the third day from the onset, and would not have the shotty feel, or go on to the formation of the vesicle, pustule, and scab of variola. From measles it would be distinguished by the absence of the catarrhal symptoms, by the rash being more raised, not crescentic, and in many cases the papules would increase in size in a way those of measles never do. It differs from eczema papulatum in the large size of the papules, the duller red colour, their being convex instead of acuminate, and in the absence of severe itching. E. tuberculatum is somewhat like urticaria, but the absence of itching and burning, which is slight at the most, and the colour, which is much deeper than the pink stage of the wheal of urticaria, would certainly distinguish it. The large diffuse patches might be mistaken for erysipelas; but the symmetry and the eruption being more raised, and the constitutional symptoms not so severe, are sufficient points of difference. There can be no difficulty about herpes iris, as it is so very distinctive.

E. nodosum is also very characteristic. The lesions may, however, resemble syphilitic nodes; but they lack the hardness of the true nodes, and are symmetrical, while nodes of the tertiary period are not, and the history and other symptoms of syphilis would be absent.

The *prognosis* is good for all forms of these erythemata, and the disease rarely lasts longer than from two to four weeks. In all but E. nodosum relapses are almost sure to recur sooner or later.

Treatment.—Since the disease tends to run spontaneously a short course towards recovery, active treatment is seldom required; a saline aperient may be given, and afterwards ferruginous tonics, the perchloride acting the best; in many cases, however, the disease runs its own course uninfluenced by drugs. Guarding the patient against changes of temperature is always desirable, and when cases hang on longer than usual, precaution and rest of mind and body are absolutely necessary, and are often followed by immediate improvement. For local applications, calamine lotion, consisting of Pulv. calaminæ gr. xl., Zinci oxidi gr. xxx., Glycerini ♏xv., Aquæ rosar. f℥j., applied three or four times a day, and allowed to dry on, is sufficient, or if there is itching present, Liq. carbonis detergentis ♏x. may be added to the above lotion.

In Herpes iris a lotion of Liq. plumbi subacetatis ♏x. to Aquæ destillatæ f℥j. allays the itching and burning; but internal treatment appears to have no direct effect on the eruption; tonics are, however, often indicated in patients who are attacked with this affection, and defects in health should be carefully sought for, and, if possible, removed.

In Erythema nodosum resting the limbs in a horizontal posture is necessary, and lead lotions afford some relief sometimes, being more grateful when applied warm. Iron is often indicated after any digestive derangement has been dealt with. Be the fluctuation of the swelling ever so marked, it should never be opened, as absorption invariably takes place.

H. RADCLIFFE CROCKER.

ESCHAROTICS. *See* CAUSTICS.

ESMARCH'S BLOODLESS METHOD of operating has, besides reducing the mortality of major amputations, rendered easy what were previously difficult dissections. He applies an elastic bandage to the limb from the toes or fingers upwards, to beyond the site of operation, with sufficient firmness to render the limb bloodless; and where the bandage ends he encircles the limb two or three times with an elastic tube. On removing the bandage, the limb is found so bloodless that operations may be performed upon it with the same facility as upon the dead subject.

Esmarch's elastic tube is provided with a hook at one end and a chain at the other; another method of fixing the tube is to have a tape attached to each end of it, by means of which a knot may be tied, which it is easy to undo. Foulis' catch is, perhaps, the best method of securing the tube; it consists of a vulcanite pad, perforated by two holes, somewhat less in diameter than that of the elastic tube; one of them opens on the surface by a slit, and the tube is threaded through the other; the pad is placed over the artery, and after the limb has been sufficiently constricted by the elastic tube, the ends of it are pressed through the slit into the tubular catch, by which they are securely held when the traction is removed. To avoid the severe constriction of the elastic tube in long operations, an india-rubber band, wound two or three times round the limb, may be substituted for it; for this purpose, Nicaise's belt, with a hook attached to one end, and a number of eyes fixed to the bandage behind it, is a good contrivance.

Some care is required in applying the elastic tube close to the trunk, as it is liable to slip. For operations involving the upper part of the thigh, it should be wound once or twice round the limb as high up as possible, the ends crossed in front of the groin, and then carried round the pelvis and fastened over the hypogastrium. For operations on the male genital organs, it should be wound round the root of the penis and scrotum together, and fastened as above described. For amputations or excisions of the shoulder-joint, the tube should be placed beneath the axilla, and the ends drawn forcibly upwards and fixed over the acromion by a Foulis' catch; it should be held in position by a broad hook, as there is a tendency for it to slip over the point of the shoulder. Esmarch states that previous to the introduction of antiseptics he had reduced the mortality of his amputations of the leg and of the thigh from thirty-six per cent. to eight per cent.; his method is, moreover, extremely useful in dissecting operations, such as the removal of deep-seated tumours, or the extraction of splinters from the hands and feet. It facilitates the examination of diseased joints and the removal of sequestra from necrosed bones; it renders major amputations possible without skilled assistance, and the elastic tube forms a good popular tourniquet, which frequently proves most effectual in the hands of railway officials, as its use involves no anatomical knowledge.

A serious objection, which has been raised against Esmarch's method, is that it is followed by such copious oozing from the stump that the total amount of blood lost is not much lessened by it. This after-bleeding has been commonly attributed to vaso-motor paralysis; but Lister argues that this is hardly likely to occur when there is neither motor nor sensory paralysis, and states that when the more even pressure of an elastic band is substituted for the tube, it may be applied long enough to cause the afterblush without any affection of either motion or sensation. He therefrom draws the conclusion that there is a demand for blood in the tissues, and that this acts as a stimulant which causes the arterial relaxation. This explanation does not commend itself to the mind of the writer, and the more probable explanation appears to him to be, that the functional activity of the muscular fibres of the arteries is lowered on account of insufficient supply of blood, and that consequently they allow of more than usual dilatation under the pressure of the blood-stream when the bandage is removed.

Cold has been used to check this oozing, but, in America, Brown has recommended, as preferable to both cold and electricity, that the surface of the stump should be washed with hot water at a temperature of 160° F. Latterly Esmarch has adopted pressure and elevation. Before removing the tourniquet, he secures all the vessels he can find, stitches up the flaps, applies the dressing, and bandages the stump tightly; he then places the limb in an elevated position, and removes the tourniquet. By this procedure, Esmarch states that his method becomes absolutely bloodless. The free oozing after operations on bone can be easily controlled by pressure. It has been urged, on little or no evidence, that Esmarch's method favours sloughing of the flaps, and may cause paralysis or gangrene of the limb; and Weir, of New York, has credited it with a death which he attributes to overstrain of a fatty heart. It seems probable that clots might be dislodged from thrombosed veins, and foul discharges be forced into the cellular spaces and lymphatic vessels by the elastic bandage, so that it is better, in cases where either of these mishaps is possible, to substitute for it simple elevation of the limb.

Before the introduction of Esmarch's method, Lister had obtained the same bloodless condition of limbs by elevation, followed by the application of an ordinary tourniquet; and he has shown that there is another factor besides gravity which operates when the limb is raised, viz. that there is an active contraction of the arteries, which reduces their calibre to nearly that of extreme constriction. Lister's method, combined with the elastic tube, is, perhaps, the best for general application; and it is only in cases where it is desirable that the surgeon should see clearly all the parts involved, as in the removal of sequestra from bones and in deep dissections, that Esmarch's method offers special advantages. The use of an ordinary tourniquet is very advisable in amputations where the operator is short-handed of good assistants, since by it he can control the flow of blood in the arteries as he chooses. BILTON POLLARD.

ESMARCH'S INTERRUPTED SPLINT, for excision of the *Wrist*, consists of a plate of sheet iron for the palm of the hand and a tin splint for the back of the forearm, connected with one another by an iron bar which arches backwards from the front of the former to the front of the latter; the wrist is left quite exposed, and so allows of an efficient antiseptic dressing being applied. Esmarch's interrupted splint for excision of the ankle is made on the same principle.

BILTON POLLARD.

ESMARCH'S OPERATION. *See* JAWS, Closure of the.

ETHER-SPRAY.—Richardson's ether-spray apparatus has a narrow-mouthed 6-oz. bottle fitted with an india-rubber cork, pierced by two metal tubes lying close to each other. These are bent to a right angle, a short distance above the cork, so that one lies below and in front of the other. Each terminates above in a firm nozzle, that of the inferior tube being at right angles to the tube. The two nozzles are therefore at right angles, and their points are closely approximated. The anterior tube ends below almost at the bottom of the bottle, and is guarded by a fine strainer; the posterior ends just below the cork, above the ether. Through the latter tube a stream of air is kept flowing by means of a strong india-rubber ball-syringe (worked by hand or foot), and it is rendered constant by passage through a distended elastic bag, placed upon the pipe leading from the syringe to the posterior tube just above the cork.

The apparatus works as follows:—The bag is kept tensely filled with air by the intermittent working of the syringe, and forces a constant current into the posterior tube. Here the stream divides, part passing down into the bottle above the ether and forcing the fluid up the anterior tube, but the chief part, passing upwards and escaping by the superior nozzle, blows the ether issuing from the lower one into a fine spray. The rapid passage of the current of air over the lower nozzle tends to produce a vacuum in the lower tube, and this alone is sufficient to cause the ether to rise to the point.

The sulphuric ether used should be absolutely pure, of sp. gr. 0·720–0·722, i.e. it should be that which boils at the lowest temperature, volatilizes most rapidly, and therefore abstracts heat most quickly from the body. As easy tests of its suitability Richardson gives that (1) it should be neutral; (2) a drachm or two poured into the palm of the hand, warmed by breathing through it, should boil briskly, causing merely a sense of coldness; (3) blotting paper wetted with it, and laid on a warm hand, should be dry in a minute, and should retain no stain or smell.

Stanley Boyd.

EUSTACHIAN CATHETER.—This instrument is a tube rather more than six inches in length, made either of silver or vulcanite. One end is funnel-shaped, about a quarter-of-an-inch in diameter; the other is curved at an angle of 135° to the rest of the catheter for about its last inch. A ring is fixed to the side of the funnel-shaped extremity corresponding with the concavity of the curved end, and indicates the direction of the point of the catheter when it is in the naso-pharynx. Eustachian catheters are generally made of three sizes. The curve of the instrument can be altered at will to suit special cases.

EXANTHEMATOUS NECROSIS. *See* Jaws, Diseases of the.

EXCISION OF JOINTS. *See* Joints, Excision of.

EXFOLIATION. *See* Necrosis.

EXOMPHALOS. *See* Umbilical Hernia.

EXOPHTHALMIC GOÎTRE. *See* Thyroid Gland, Diseases of the.

EXOSTOSIS. — An exostosis is a limited outgrowth of bone from some of the osseous structures of the body. The diffused periosteal growth that is often left after chronic periostitis is not spoken of as an 'exostosis,' nor the osteophytic growths which occur around the joints in osteo-arthritis.

Causes.—Nothing is known for certain as to the causation of exostoses. In some cases—and these are nearly always of the multiple symmetrical variety—they are hereditary. These bony growths are of two kinds—the ivory and the spongy exostosis.

The *ivory* or hard exostosis is developed from the fibrous periosteum, and, as in the case of the bones of the skull, is due to ossification in membrane. It occurs chiefly on the flat bones, such as those of the skull, orbit, scapula, and pelvis. As its name implies, it is of very remarkable density, resembling in structure the cortical layer of bone from which it springs. It is generally single, and causes little or no inconvenience, except in rare instances when it encroaches on a cavity, such as that of the skull or orbit. An ivory exostosis growing in the frontal region of the skull may attain an enormous size, and is chiefly known by specimens in our pathological museums.

The *spongy* or cancellous exostoses occur mostly at the epiphysial lines of the long bones, are generally multiple and developed from cartilage, with a thin layer of which they are most frequently covered. When present in considerable numbers they are generally distributed symmetrically, and will be met with chiefly at the lower ends of the femora, at both extremities of the tibia, and at the upper end of the humerus. They are most frequently seen at puberty, and rarely, if ever, found after the age of twenty-five, and, with the above peculiarities, will often be found to be hereditary. They are composed of cancellous tissue, which is continuous with that of the bone on which they are situated, the cortical layer at the base of the tumour in each case being absorbed. They generally cease to grow when the growth of the bone to which they are attached is arrested. The thin cap of cartilage on the surface then ossifies, and becomes continuous with the cortical bone of the shaft upon which the tumour is placed. They sometimes, however, commence after the general growth has ceased, and then often attain considerable size, becoming large, irregularly lobulated tumours, with a comparatively small peduncle.

The *subungual* exostosis is also a spongy or cancellous bony growth, with a thin covering of cartilage. It occurs at the free border of the nail of the ungual phalanx of the great toe. It has occasionally been seen on the little toe, and a few instances are recorded on the distal phalanges of the nand. It is of some clinical importance on account of the frequency with which it is still mistaken for an ingrowing toe-nail.

The *symptoms* of an exostosis need scarcely be given in detail. It is a hard, bony outgrowth, fixed to one of the osseous structures of the body. When it occurs on the extremities and at points of pressure, a bursa is not infrequently developed on the summit, which, with the other soft structures, is projected in front of the exostosis. The secondary symptoms which these bony growths produce are entirely due to the position which they may happen to occupy. An exostosis very rarely causes any pain or discomfort, and very slowly increases in size; but when it occurs about the frontal region of the skull, and in the neighbourhood of the orbit, it may so displace the eye as to produce a hideous deformity, and at the same time destroy the eyesight.

The cancellous exostosis in the neighbourhood of a joint may also so interfere with the movements of the articulation as to considerably impair the function of the limb, or if it be situated on the inner side of the knee, on either the tibia or the femur, it may so diminish the patient's power of grasping the saddle as to effectually prevent him from riding.

As regards their diagnosis from one another, the cancellous exostoses are generally known from the position they occupy, the age at which they appear, and from their number, whilst the ivory exostosis is generally single, occurs only on the flat bones, and is seen at almost any period of life.

Treatment.—From the above account it will be seen that in most cases an exostosis should be left alone. An ivory exostosis is sometimes so hard as to defy the best instruments, and the dangers of such an operation as an attempt at its removal involves, ought not to be lightly incurred. If, therefore, these growths are producing no inconvenience and no secondary symptoms, it is better not to interfere with them. But occasionally it becomes necessary to attempt some means of relief, and the records of cases tend to prove that the thorough exposure of the base of such a growth, and the application of some mineral acid or other escharotic to the peduncular part of the exostosis, is the best and simplest means of inducing necrosis.

An inflammatory action set up at the root of an ivory exostosis seems to be a surer method of eventually removing this dense structure than an attempt by violent means to detach it from the skull by the saw or chisel. Occasionally such an exostosis has a very small peduncle, and may be easily detached; but should this not prove to be the case, it is better to try the frequent application of some escharotic than to persevere for any length of time with surgical instruments.

The cancellous exostoses generally cease to grow when the skeleton is fully developed. It is therefore unwise and unnecessary to operate in these cases, except when, from the position of the exostosis, the function of the limb is seriously impaired—as, for example, on account of its proximity to the knee-joint, the articulation which is most frequently affected in this way. Or, again, in the case of great pain and frequent neuralgia from the pressure of the exostosis upon a nerve. For these reasons, and for the deformity which it occasionally produces, an operation for its removal may have to be undertaken. In most cases the excision may be easily and quickly accomplished, the base being of soft consistence and small dimensions; in others the point of attachment being wide and of great density, the removal may involve the use of many instruments and considerable force. The operator should provide himself with different forms of cutting bone-forceps, chisels and mallet, various kinds of small saws, and a chain-saw. Sometimes the pedicle has proved, on exposure of the growth, to be formed of tough, fibrous tissue, which, on account of its shortness and strength, has allowed no perceptible mobility to the exostosis till the soft parts have been divided and the tumour completely exposed. The scalpel will, in such a case, be the only instrument necessary to complete the operation.

In using instruments close to a joint or a large vessel, the operator must be careful to work with the cutting edge directed away from the point of danger.

The subungual exostosis should be removed with the gouge or sharp spoon after an incision has been made through the soft parts round its base, so that the horny cuticle and cartilaginous cap on its summit may be taken away at the same time. If this cartilaginous cap is not removed, the growth is likely to return.

The operations are now almost invariably conducted with antiseptic precautions, but the dressings may be of dry absorbent wool (iodoform or salicylic) or of wood wool (corrosive sublimate), contained in convenient bags made from muslin which has been similarly prepared. This application may be retained for a few days, and can in most cases, after the first change of dressing, be left till the healing is complete, as the tissues generally unite by first intention.

There is now much less fear of dangerous consequences from these operations, which must, as a rule, involve the cancellous tissue of bone, than there was in former days. The dread of suppuration in the veins of the cancellous tissue led to the trial of the subcutaneous division of the neck of the growth, and also of fracture of its neck by external force without incision of the soft parts. The loose body was then daily moved to prevent its reunion. But the operation has fallen out of favour in recent years, partly because it not unfrequently failed, and partly because, with modern methods of operating and dressing, the free exposure of the bone and its section in an open wound are very rarely followed by suppuration of the medullary canal and its consequences. H. H. Clutton.

EXTENSION. *See* Dislocations.

EXTRACTION OF TEETH. — The roots of a great many teeth are of such a shape that, were they implanted in rigid, unyielding bone, they could not be extracted at all. The art of skilful extraction lies in a knowledge of the directions in which the bone around a normal root will best yield, and in quick recognition by the sense of touch of any alteration in this respect induced by abnormal curvatures of the roots. The blades of tooth-forceps should be thin, almost sharp-edged; they should be lightly closed upon the tooth, and then forcibly driven up so as to pass deeply between the tooth and the gum, right down to and a little within the edge of the socket. It is never necessary nor desirable to lance the gum previously, save in the case of lower wisdom teeth, to the necks of which a tough gum is sometimes strongly adherent and might be torn in the removal of the tooth. As the outer alveolar plate is much thinner, and thus more yielding, than the inner, the first movement should be inwards, so as to slightly disengage the outer portion of the root from its socket, and then much more extensively outwards, the extraction of the tooth being accomplished almost without any direct pulling. As exceptions, the four upper incisors, having cylindrical roots, may be best disengaged by rotation, and lower wisdom teeth will often move inwards more easily than outwards; their roots are often strongly curved backwards, in which case the elevator is the most appropriate instrument for their removal.

The bone of the alveolar borders is very intolerant of injury, and seems to have little recuperative power, so that the exfoliation of small fragments of the socket not rarely results, especially where unusual force has been used; an ostitis involving the whole socket and causing much pain is a less common sequela. Little can be done for these conditions save fomentation and the abundant use of disinfectants, such as Condy's fluid. *See* Alveolus, Fracture of the.

Such complications are more apt to ensue when there has been, prior to the extraction, acute inflammation; but it is quite a mistake to suppose that it is desirable to wait for the subsidence of all swelling and inflammation before resorting to the extraction of the tooth; for though the healing may be slower, nevertheless it is a far shorter road to relief than to wait for the inflammation to wear itself out and then to extract—a method of practice which results in much needless suffering.

The accidents most liable to happen are the fracture of portions of the alveolus, the accidental removal of more than one tooth, the passage of a root into the antrum, its escape from the instrument down the œsophagus or the trachea, or excessive hæmorrhage. Fractured alveolus pressed back into position commonly stays there without support, and reunites; a tooth removed by mistake and promptly replaced in its socket also, in the majority of cases, refastens; a root may generally be got out of the antrum by forcible syringing, after enlargement of the opening, and the swallowing of a tooth is not likely to lead to any harmful result. A tooth is very unlikely to get through the glottis unless the patient is under an anæsthetic; of the cases on record, most have terminated by the tooth being coughed up after a longer or shorter interval, but some few cases of serious and even fatal mischief having been set up in the lung have occurred.

Hæmorrhage is best treated by mechanical means, aided by astringents; strong caustic applications, like perchloride of iron, leaving a surface not capable of speedy healing, even if they do not create fresh bleeding surfaces more difficult to control than the tooth-socket. The extracted tooth itself makes an admirable plug, or the socket may be plugged with fragments of moistened matico-leaf, and firm pressure made upon it by a roll of lint held in position by the opposing teeth. If this be carefully done it is very rare for further measures to be called for. Charles Tomes.

EXTRA-UTERINE FŒTATION.—This term signifies the development of a fœtus either entirely beyond the anatomical limits of the uterus, or at least away from the true uterine cavity. Cases of fœtation in one horn of a bicornute uterus, or in a pouch forming a diverticulum from the cavity of the uterus, cannot be strictly considered as belonging to this pathological condition. In a very large majority of the recorded cases of extra-uterine fœtation, the Fallopian tube was the seat of the abnormal pregnancy, and some authorities believe that nearly all the other varieties are primarily tubal. The different forms of extra-uterine fœtation or gestation are :—(1) Tubal gestation, including the tubo-uterine or 'interstitial,' tubo-ovarian, and tubo-abdominal varieties. (2) Ovarian gestation, the existence of which, in the literal sense of the term, is doubted by many pathologists. (3) Abdominal and pelvic gestation, including all cases where the ovum is entirely, or almost entirely, disconnected from the uterus, tube, or ovary. This variety may include cases where the ovum lies between the two folds of the broad ligament. Systematic writers make separate varieties out of cases where the placenta has been found in the uterus, the fœtus lying in the Fallopian tube or in the abdominal cavity, the umbilical cord passing along the tube.

The occurrence of extra-uterine fœtation has been proved by actual dissection to be associated, in many cases, with obstruction of the canal of the Fallopian tube, and consequent arrest of an impregnated ovum by mechanical agencies, such as the pressure of inflammatory bands of adhesion, kinking or extreme angular flexion of the tube from various causes, and morbid growths either within the canal or at its uterine orifice. Various sexual and menstrual irregularities have been given as causes of extra-uterine pregnancy, but seldom on satisfactory evidence. It has been alleged that excessive manual labour shortly after conception may bring about this condition. After a twin conception, it is very probable that one of the ova may obstruct the other in its passage along the tube; as, in nearly four and a half per cent. of a series of five hundred cases, extra-uterine fœtation was coincident with uterine pregnancy. It has been maintained by some authorities that the uterus is the normal seat of conception, and that spermatozoa do not naturally permeate the Fallopian tubes in women, but, on the contrary, are prevented from entering them. According to this theory, it is only when chronic morbid changes in the tubes have brought about dilatation and changes in their mucous membrane, that the passage of spermatozoa along their canals is possible, and then one of these organisms may readily encounter an ovum, and impregnate it. The fertilised ovum immediately adheres to the mucous surface with which it happens to be in contact, and tubal pregnancy is the result. Extra-uterine fœtation is most frequent in multiparæ; but, in a considerable proportion of recorded cases, the abnormal gestation had occurred either at the first pregnancy and long after marriage, or at a long interval after a previous pregnancy.

TUBAL GESTATION.—As the ovum passes from the ovary to the uterus through the tube, it is not surprising that it should be arrested, under some of the above-mentioned conditions, in some part of the Fallopian tube, developing, if impregnated, into a fœtus. A more or less spherical tumour is then formed in some part of the course of the tube. It contains the fœtus, and generally the placenta, but is not lined with a true decidua. In rare cases the placenta has been found in the uterus, the umbilical cord passing into the tube. After the death of the fœtus, the placenta sometimes lives and hypertrophies. The uterus almost always enlarges, probably always when the pregnancy is at all advanced; a decidua forms within its cavity, and in the few cases where it has been reported absent, it had probably been passed unnoticed. The walls of the cyst containing the fœtus are thin and tense, and tend to rupture between the third and fifth months, not half the cases carrying the child to term. The nearer the cyst lies towards the uterine end of the tube, the earlier will be the rupture. The muscular tissue in the cyst-wall probably causes partial separation of the placenta by contraction, and the consequent hæmorrhage distends the cyst till it bursts. After rupture, life may be prolonged until a second or third recurrence of hæmorrhage; or the bleeding may cease, and the patient recover.

TUBO-UTERINE OR 'INTERSTITIAL' GESTATION.—These terms are, in reality, synonymous. An ovum discovered in the uterine wall can only have been developed in the uterine portion of the tube or in a uterine pouch. On the other hand, as the calibre of that part of the tube is very narrow, it is probable that, when a fœtus develops within it, partial rupture will soon occur, so that the fœtal sac will be brought into direct relation with the uterine wall. Six specimens, described as 'interstitial' gestation, are to be found in London museums. In four out of these, the condition of the affected parts is intelligibly displayed, and in all these four the tubal origin of the 'interstitial' cyst is self-evident. A tortuous condition of the uterine portion of the Fallopian tube has been proved to be a predisposing cause of this variety of abnormal gestation. As the uterine tissue around this portion of the tube is thinner than in any other part of the uterus, rupture of a tubo-uterine cyst generally occurs very early. However, as the stimulus of gestation always causes a certain amount of hypertrophy of the uterine tissue, the walls of the sac are sometimes of considerable thickness. Although pathologically tubal, this form of abnormal gestation is, surgically, uterine; the removal of part of the cyst, or even mere incision, without wounding part of the uterus being, of necessity, impossible. As a part of the cyst bulges into the true cavity of the uterus, there is a possibility that the ovum may be discharged into the uterus, as certain clinical records would appear to prove; and should the abnormality of gestation be diagnosed, the surgeon will have the opportunity of incising the layer of uterine tissue which divides the fœtus from the uterine cavity.

TUBO-OVARIAN AND OVARIAN GESTATION. The possibility of ovarian gestation has been much disputed. A fœtal sac, which is apparently in the outer or lower part of the ovary, may very possibly be tubal; for the Fallopian tube does not naturally lie entirely above the ovary. Its outer part, including the dilated portion close to the fimbriæ, descends and bulges behind the ovary; hence the fimbriæ lie on the outer surface of that organ, the lower even reaching its inferior aspect, whilst the longest, the 'ovarian fimbria,' actually ascends the surface of the ovary, instead of descending as represented in most diagrams. When the fimbriæ are matted together from morbid changes, and the tube obstructed and dilated, it will be found that half the dilated tube coils round the outer and lower aspect of the ovary. In the same manner, when a fœtus develops within the fimbriated extremity of the tube, it forms a tumour lying external to, or even partly below, the ovary, and often encroaches on ovarian tissue. Many observers, not cognisant of the above fact, have taken tubo-ovarian for ovarian pregnancy. The writer once dissected the uterus and appendages in a case where a patient had died from rupture of an extra-uterine cyst, the existence of which had been unsuspected during life, amenorrhœa having existed for a year, and the cyst having felt like a multilocular ovarian tumour. The ovarian ligament appeared to run from the uterus to the inner surface of the cyst; a cardinal proof, in most cases, that a tumour springing from the uterine appendages is truly ovarian. But on dissection it was found that the tissue on which the ovarian ligament ran was a small and distinct ovary, squeezed flat between the uterus and the cyst, to which it was soldered by adhesions. The cyst was distinctly tubal. This squeezing up of the ovary may be seen in early stages of tubal gestation. Hence the writer is compelled to distrust the evidence of several authorities as to the occurrence of cases of ovarian pregnancy in their practice, based on the fact that the ovarian ligament ran on the surface of the cyst. Tubo-ovarian pregnancy signifies gestation in the outermost part of the tube, and in this variety the tissue of the ovary is rapidly encroached upon by the sac.

ABDOMINAL GESTATION.—It has been doubted whether an ovum can drop out of the Fallopian tube after impregnation, and fall into the peritoneal cavity; and it is not certain that an unimpregnated ovum can be fertilised after straying on to the peritoneum, although it has been stated, upon good authority, that spermatozoa have been found on the surface of that serous membrane near the uterus, and that, in tubal pregnancy of one side, the corpus luteum corresponding in its degree of development to the abnormal pregnancy has been found in the opposite ovary. The great majority of cases of abdominal gestation arise from rupture of a tubal cyst. True pelvic or broad-ligament gestation must be included in this category. Rupture of the tube along its free surface is, as a rule, followed by hæmorrhage and death of the fœtus at least; whilst, should the fœtal cyst be rent between the two layers of the broad ligament as they pass under the tube, the embryo might readily escape into the cellular tissue of the ligament, which would offer resistance to hæmorrhage. Its life might then be spared, and it would develop in its new cavity, forming a tumour that would soon become partly abdominal. Should the fœtus survive rupture of the tube along its free surface, true abdominal gestation would occur. The placenta in these cases is sometimes found adherent to some of the abdominal viscera. When it becomes attached to the serous coat of the intestine, the mucous membrane of the latter tends to become congested; and if the fœtus should die, the placental vessels may convey septic material from the intestines to the fœtal tissues. Hence, as Freund has pointed out, diarrhœa or dysentery followed by symptoms of septicæmia in cases of extra-uterine pregnancy, affords strong evidence that the placenta is adherent to intestine.

Symptoms and Diagnosis.—The existence of extra-uterine pregnancy has been repeatedly diagnosed before rupture of the cyst, but in many cases the symptoms have misled the most experienced authorities. In the earlier stages, it is the pregnancy that is most in evidence; in the later, the tumour. When a woman believes herself to be pregnant, or has ceased to menstruate for two or three months, and suffers from crampy or colicky pains in the hypogastrium, or in one iliac fossa, pains of marked severity, and more or less paroxysmal, there is always good reason to suspect extra-uterine pregnancy, especially if the woman has never been pregnant before, or not for many years. If there be characteristic changes in the breasts, with discolouration of the vulva, enlargement and partial displacement of the uterus, and the formation of a tumour which can be detected above the pubes, or on one side of Douglas's pouch, the diagnosis of extra-uterine pregnancy will be all but certain. Subsequent symptoms of abortion, with the discharge of a decidua, but no ovum, will be of grave import in such a case, being the harbinger of rupture of the cyst. If the abnormal pregnancy be advanced, a soft tumour, resembling a pregnant uterus, may generally be detected in the abdomen, the uterus being found on vaginal examination to be more or less enlarged, but separate from the tumour. Should a so-called 'placental' souffle, and, above all, the fœtal heart-sounds, be heard on auscultation over the tumour, the nature of the case will be very evident. Active fœtal movements, perceptible through the abdominal walls, do not, in themselves, constitute an important proof of extra-uterine pregnancy, as they are usually observed in normal gestation when the patient's abdominal walls are thin. Rupture of the cyst gives rise to severe pain, collapse, and all the symptoms of intra-abdominal hæmorrhage. It may, in rare cases, cause instantaneous death; more frequently the patient rallies for a few hours or days, and sinks under a return of the symptoms. Schröder and Freund have shown that spontaneous recovery is not so infrequent as was once supposed. In cases of fatal rupture of the cyst, murder or suicide, especially by poison, may be suspected when the true nature of the patient's case has been overlooked; but the real character of the accident may be proved with facility by a carefully conducted necropsy.

On the other hand, many of the above important symptoms may be masked or absent. Menstruation had ceased, in one case under the writer's observation, for twelve months before fatal rupture of a tubal cyst; and it has in several cases persisted—as in one instance where rupture occurred during coition, in a patient who was suckling, and in whom the catamenia had not been suppressed during lactation, the last period having ceased two days before the accident. Occasional hæmorrhage from the uterus is frequent during extra-uterine gestation, and has been mistaken for menstruation. The death of an extra-uterine fœtus at term causes symptoms of what is known as missed labour. When such symptoms as labour-pains and hæmorrhage from the uterus, with no subsequent expulsion of a fœtus, are observed, it must be remembered that retention of a dead fœtus in the uterus after term is not proven, whilst the retention of a dead extra-uterine fœtus in the abdominal cavity for months or years has been repeatedly observed.

The colicky pains are sometimes absent, especially in the abdominal and tubo-ovarian varieties of abnormal gestation; they are also met with in certain chronic uterine and ovarian affections. The changes in the breasts and vulva may be obscure or absent in the earlier stages of extra-uterine, as in the same periods of normal pregnancy. In several cases, of which accurate clinical records exist, the uterus was not enlarged, and was but little, if at all, displaced. The fœtal cyst is not always easy to detect, especially in stout subjects. In true abortion the ovum may escape undetected, and the presence of an enlarged ovary may mislead the practitioner. The tumour, when large, may readily be taken for an ovarian or a uterine growth, especially if the fœtus be dead, so that the souffle and heart-sounds are absent, and if the other physical signs of pregnancy be wanting. The co-existence of extra-uterine fœtation and abdominal or pelvic tumour, may greatly increase the difficulties of diagnosis. A souffle is occasionally heard in large soft uterine fibroids. In one case, an abdominal tumour and a gravid uterus were detected in the same patient. Fœtal heart-sounds could be heard on auscultation of the uterus, but not when the stethoscope was applied to the tumour. The ultimate course of the case showed that twin pregnancy had occurred, the extra-uterine fœtus having died.

Rupture of the cyst produces pelvic hæmatocele in cases where the patient survives the accident for a few days; in one case, at least, a hæmatocele formed through another cause whilst tubal pregnancy existed. The absence of coma and dyspnœa distinguishes the symptoms of hæmorrhage after rupture of the cyst from intracranial and intrathoracic hæmorrhage, but its distinction from intra-abdominal hæmorrhage, due to other causes, will depend on a careful consideration of the history of each individual case, and is often impossible. Lastly, the symptoms produced by the retention of an extra-uterine fœtus beyond term are often very puzzling; there must of necessity be an abdominal tumour; and if the contents be discharged through a communication with the intestine, bladder, vagina, or abdominal wall, portions of the fœtus will be recognised. When, however, the fœtus has undergone degenerative changes, with simultaneous atrophy of the placenta, the tumour may resemble a uterine fibroid growth, a dermoid ovarian cyst, or even a malignant tumour of the omentum or abdominal viscera. A calcified fibroid tumour and a 'lithopædion' closely resemble each other to the touch. Here again, the surgeon must rely as much upon history as upon physical signs.

Treatment.—Extra-uterine fœtation is a very grave affection. Rupture of the cyst at or after the third month is the most frequent termination of the case; and this accident, though not so surely fatal as was once supposed, very frequently causes the patient's death. If the patient survive the full term, she must incur numerous risks through the presence of a dead fœtus in the abdominal cavity. Diagnosis is not always easy, as has been explained; but a simple exploratory incision through the abdominal walls—an operation which experience has shown to be almost free from risk when antiseptically performed—will prove the nature of the case; and it must be remembered that many diseases which have been taken for extra-uterine fœtation are equally or still more suitable for operative measures. Before speaking of the radical cure of this affection by removal of the fœtus through an abdominal incision, it must in the first place be observed that, when abnormal gestation of this class is suspected, the patient must be kept at rest as much as possible. To allay the crampy pains, opiates, especially hypodermic injections of morphia, are of high value. Inhalations of chloroform are not advisable, as the struggling before anæsthetisation, and the frequent vomiting afterwards, might cause rupture of the cyst. An abdominal belt, light diet, and a regular daily action of the bowels, are further requisites in cases of this kind. It is certain that these palliative measures have sometimes saved the patient, if we may trust the diagnostic powers of several obstetricians, the fœtus perishing early in the pregnancy and its sac shrivelling up.

Incomplete operative measures cannot be said to have yielded a favourable series of results, although all have saved life in a few cases. Among these measures are—killing the embryo by strong electric shocks or galvano-puncture, injections of narcotics into the cyst, puncture of the cyst in order to destroy the embryo by drawing off the liquor amnii, and removal of the embryo by section of the vagina with the galvanic cautery. This last operation is neither easy nor safe; it is done in a region which cannot be thoroughly exposed to light, and where manipulation is very difficult. A powerful electric shock, sufficient to cause the death of an adult by its stimulation of the inhibitory fibres of the pneumogastric nerve, might have little or no effect on a fœtus, which has no inhibitory apparatus. This form of electricity has, moreover, often proved a failure in recorded cases. Electrolysis has also failed in its object; in one case the fœtus survived its influence after tapping and morphia injections had been tried for the same purpose. A fœtus has survived the injection of two grains of morphia. Drawing off the liquor amnii is still recommended by distinguished authorities; it is not a difficult proceeding, but does not always kill the fœtus, however completely the fluid be removed, and it not unfrequently results in the death of the patient by hæmorrhage or septicæmia. If the fœtus be killed by any of the above methods, its remains will probably be discharged through fistulous communications between the sac and the rectum or vagina, during which tedious process the patient will be seriously invalided.

The removal of the fœtus by an abdominal incision is an operation which is yearly growing into greater favour, as the true course to be pursued when extra-uterine gestation is diagnosed. To expose a Fallopian tube ruptured at an early stage of extra-uterine fœtation, to clear out the clots and fluid blood with which the peritoneal cavity is filled, and to remove the tube and its embryo-bearing sac, after ligature of the uterine appendages as in ovariotomy, is an operation of great difficulty; yet it is advocated by, and has been successfully performed by, Mr. Lawson Tait. When an unruptured cyst, in a late stage of pregnancy, is exposed by an abdominal incision, the operation is not so arduous; besides, the patient is, as a rule, in a less desperate condition. The abdominal wound must be made as in ovariotomy, and the sac opened cautiously, as the placenta is sometimes attached to its front surface. The sac should then be stitched to the margin of the wound, incised, and a small portion of its wall removed. The fœtus must then be extracted, and the umbilical cord divided. During these manipulations care must be taken not to disturb the placenta. The sac must then be well washed out with antiseptics, and a drainage-tube should be passed into it as deeply as possible; it must also be packed with antiseptic dressing. The placenta will come away in a short time, and the wound, after daily antiseptic washing and packing, may be closed when blood and broken-down tissue cease to issue from the tube. The operation has been successfully performed, both before term, and in cases where the fœtus had been retained for months beyond the normal period of gestation. The operator should not attempt to remove the cyst itself, as its precise nature, and its connection with other parts by adhesions, cannot always be ascertained by abdominal section, and when left behind and drained it atrophies, and causes no inconvenience to the patient.

In cases where the bones of an extra-uterine fœtus are discharged through a fistulous opening in the rectum, vagina, or abdominal wall, it may be necessary to enlarge the opening and thoroughly empty the contents of the abnormal cavity, employing antiseptic solutions and drainage. The cavity must be explored and syringed out with great care, lest any adhesions be disturbed.

Tubo-uterine or 'interstitial' pregnancy is not easily diagnosed; if it be detected during abdominal section, it is difficult to advise any other course than amputation of the uterus above the cervix. If diagnosed before operation by dilatation of the os uteri, the method already suggested in the paragraph on tubo-uterine gestation might be practised, as involving less risk than hysterectomy. Alban Doran.

EXTRAVASATION OF URINE.—The escape of urine from the urethra through rupture of the wall of the passage. This rupture is occasionally produced by accidental injuries, such as falls or blows on the perineum, which tear open the urethra in that situation. A more common cause is yielding of the urethra behind a stricture, which has long obstructed the flow of urine and gradually dilated the portion behind the contraction until complete, or almost complete, retention takes place. The weak expanded portion may give way suddenly during a violent effort to expel urine. In this case the patient feels a momentarily sharp, stinging pain, and then for a little while relief from the urgent call to void urine, through some of the contents of the bladder escaping into the cellular tissue around the urethra.

A more frequent mode is for the urine to penetrate into a small abscess that has formed in a follicle of the expanded urethra. In this case the escape of the urine is slow and limited to the track of the abscess, which then passes forwards and forms some variety of perineal abscess, ultimately reaching the surface of the body and opening a fistula for the escape of the urine from the urethra behind the stricture. Such gradual and limited escape, though a grave affection, is attended with far less constitutional disturbance and danger than the acute form, with extensive infiltration of urine into the cellular tissue.

If the extravasation is suddenly produced during violent straining, the urethra has given way at the membranous portion between the two layers of the triangular ligament (deep perineal fascia), where it is but little supported by the surrounding structures. The urine rapidly perforates through the anterior layer of the triangular ligament into the cellular tissue of the scrotum and penis, and thence beneath the integuments of the belly—sometimes as high as the nipple. The attachments of the deeper layer of the superficial fascia to the borders of the triangular ligament, to the rami of the pubes, and to Poupart's ligament as far as the crest of the ilium, prevent the urine from wandering down the thighs or backwards to the perineum. Occasionally the sloughing which follows this soaking in unhealthy urine causes the attachment of the superficial fascia to the triangular ligament to give way, when urine spreads to the ischio-rectal fossæ between the layers of the pelvic connective tissue, causing extensive sloughing of the nates and, if the patient survive, fistulæ around the rectum and beneath the glutei muscles.

The local effects of the sudden escape of urine which has become decomposed by long retention in an unhealthy bladder are very destructive; gangrenous inflammation is excited wherever it reaches. The swelling spreads rapidly in the directions named, the skin grows dull red, brawny, or boggy, crackling, or even emphysematous. The skin sloughs over the scrotum, penis, and lower part of the abdomen, and exposes fœtid, dark-coloured layers of sphacelated cellular tissue soaked with urine and serum.

The constitutional effects are often very great and always serious. The patient is never in a healthy condition before the rupture of the urethra, and is quickly and greatly prostrated. He is anxious, restless, and in considerable pain. The pulse is rapid, small, and easily compressed, the tongue dry and brown along the middle. These symptoms are followed by wandering delirium, insensibility, increasing general prostration, and in many cases death. Should the patient survive, and this is more probable if the skin sloughs rapidly, thereby affording vent speedily to the pent-up putrid urine and so limiting the area of its infiltration, recovery is sometimes very rapid. The sloughs are thrown off, healthy granulations succeed them, and the exposed parts, testes, corpora cavernosa, or abdominal aponeuroses, are quickly covered with sound scars, while the urine escapes through one or more fistulæ at the lower part of the scrotum.

The immediate *treatment* of this affection consists in setting free the pent-up urine, establishing a short course for the urine from the bladder to the surface, and in maintaining the patient's strength by means of nourishing and stimulant diet.

As soon as indications of extravasation are given, the patient should be anæsthetised and put into the lithotomy position. Then, the left forefinger being kept in the rectum to draw it away from the knife, a sharp-pointed bistoury should be pushed directly backwards, one inch in front of the anus in the raphé of the perineum until the dilated urethra is reached. A Wheelhouse's small tapering gorget can then be passed through the wound along the posterior part of the urethra to the bladder, and by its means a catheter may be guided thither, when the catheter should be tied in, and the urine allowed to drain off continuously from the bladder. The further extravasation of urine being prevented, the liberation of that which has already percolated into the cellular tissue must be obtained by several free incisions of the brawny swollen areas as far as they have reached, and made in the scrotum and penis on each side of the mesial line. The division of the stricture which has caused the extravasation may be carried out at the same time: more commonly, however, it must be left until the patient has regained some of his strength. When the stricture is too narrow or too tortuous for a staff to be passed through it, it is better to delay the treatment of the stricture till the patient have recovered from the extravasation. But if the patient have a moderate amount of strength, and the extravasation be not extensive, and if a guide staff can be carried through it to the bladder, the stricture can be dealt with at once. This is done, after the perineal incision has given access to the bladder, by passing a Syme's shouldered staff through the anterior portion of the urethra and the stricture until its beak reaches the left forefinger placed in the posterior part of the urethra. An assistant then holds the Syme's staff steadily in the perineum, while the operator, using his left forefinger as a guide, cuts the urethra from behind the stricture forward to the shoulder of the staff along its groove. The rigid instrument is then withdrawn, and a flexible catheter passed on to the bladder with the aid of the tapering gorget if needful, and tied in for a few days after the operation.

In addition to the primary treatment by perineal and other incisions, the sloughy parts should be dressed with warm wet boracic lint or with lint soaked in carbolic oil 1 in 10 or 1 in 15; the sloughy surfaces freely dusted with iodoform, and the whole covered with tarred hemp wrung out of hot water. If the patient's strength permit, he can be most thoroughly washed in a hip-bath of warm, weak solution of Condy's fluid or other antiseptic, in which also the sloughs can usually be most easily removed. The patient will need from the first bark, opium, brandy, and strong beef-tea, or any other nourishment he can take, to enable him to withstand the exhaustion that follows the sloughing of the cellular tissue and skin.

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EXTROVERSION OF BLADDER. *See* ECTOPIA VESICÆ.

EYE, General Examination of the.—The more important diseases to which the eye is liable will be made the subject of separate articles under appropriate headings; and all that will be attempted in this place is to give a general view of the chief symptoms by which ocular maladies declare themselves. The transparency of many of the tissues of which the eye is composed, and the accessibility of most of them to various modes of examination, render it easy, in the majority of cases, to ascertain the precise facts with regard to any form of ocular disease or injury. It is therefore the more necessary to utilise in the most complete manner the advantages afforded by the structure and position of the organ, and to look at it in such a way, and with such attention, that nothing which exists can escape notice. Occasional errors of inference and interpretation are, perhaps, inevitable; but an error about a matter of fact can seldom arise excepting from haste or carelessness. There are many advantages in following a settled order of investigation, and it will usually be best to proceed from the superficial to the deeper textures.

The *eyelids* will thus come first under observation, and they may depart from the healthy state in many ways; by faulty position, by swelling, by redness, or by the condition of their margins or appendages. *See* EYELIDS. Whenever there is any redness or irritation of the surface of the eyeball, it is not enough to notice the absence of coarse eyelid changes, but the state of the margins and of the cilia should be carefully scrutinised. For this purpose it is well to use a magnifying glass, and to look closely at the growth and position of the cilia, moving the eyelid a little way from the globe during the examination, so as to let the light fall at different angles from time to time. In this way fine semitransparent ingrowing eyelashes may be discovered, or sometimes a detached eyelash which has been carried into one of the lacrymal puncta and arrested there. The margins of the upper lids should be scrutinised in similar fashion, as well as the whole surface of the conjunctiva, both palpebral and ocular.

In order to examine the conjunctiva of the lower lid, the lid should be drawn down by the tips of one or two fingers, placed on the skin just above the inferior margin of the orbit. The patient should then look upwards as much as possible, and the lower retro-tarsal fold will be thrown forward and rendered prominent. In some persons a good view of the lower part of the conjunctival sac may be obtained by drawing the lower lid forward while the eye looks down. In order to see the conjunctiva of the upper lid, a somewhat less simple manœuvre is required. The lids being gently closed, the surgeon takes any slender instrument, such as a probe or a knitting-needle, and places it horizontally along the upper lid, just below the upper level of the tarsal cartilage. A slight pressure against the upper part of the cartilage inclines its lower margin a little forward, and this margin is then seized between the thumb and index finger of the disengaged hand, which obtain a light but firm hold of the cilia and the edge of the lid. The surgeon draws the lower part of the eyelid still more forward, and then with a quick movement turns it upwards round the probe, which is held immovable and acts as a fulcrum of rotation. At the moment when the upward turn is given to the lid, the patient, if not already doing so, should be told to look down, and complete eversion will be obtained.

The lid being everted, its inner surface must be examined; and it must be borne in mind that foreign bodies are especially apt to lodge on this surface, about a line from the margin. The upper *cul-de-sac* does not admit of being completely exposed, although, when the patient looks down, most of it may be brought into view. It is a not uncommon place of retreat for a certain class of foreign bodies, such as fragments of straw, or of the awn of barley; and it may be fully explored by the bent portion of a hair-pin or by a loop of wire. Eversion of the upper lid is not agreeable, and need only be practised when the history of the case, or the appearance of the ocular surface, points to the probability of some irritant being concealed beneath. Besides foreign bodies, such an irritant may be supplied by warty granulations of the palpebral conjunctiva, which are residual to chronic conjunctivitis, and are frequent causes of undue vascular development on the cornea, especially on its upper portion; while in the lower retro-tarsal fold we may find granulations of another kind—the so-called 'sago grains,' which consist mainly of aggregations of lymph-cells.

Conjunctiva and Sclerotic.—Obvious congestion of the ocular surface may be limited to the conjunctiva, or may extend to the deeper portions of the globe. Active congestion of the conjunctiva is readily produced by trivial causes, and, if these continue in operation, the congestion soon becomes chronic, from passive dilatation and loss of tone of the vessels. It may vary in degree, from a mere vascular network, with white interstices, to the production of uniform redness. Congestion limited to the conjunctiva may be distinguished by the readiness by which the vessels may be momentarily emptied by pressure. If the tip of the index finger is placed against the cutaneous surface of the lower lid, and so used as first to raise the lid a little towards the cornea and then to make it glide down again over the lower part of the eyeball, the track of digital pressure, if the congestion is only conjunctival, will for an instant be left purely white, quite up to the corneal margin. The vessels refill as the finger passes on, and obliterate its track. But if the congestion reaches deeper parts, as will happen in cases of inflammation of the iris, cornea, or ciliary body, it will involve the fine vascular zone of the sclera, which surrounds the corneal margin, and which remains unaffected by pressure. The vessels of this zone are too small to be individually visible, even when overfilled; but their distension forms around the cornea a pink annulus, which is sometimes seen through the conjunctival vascularity, and is sometimes obscured by it, but which may always be brought to light by the effect of pressure, which then leaves a track that is pink near the cornea, and becomes white at some little distance from its margin. There is yet a third form of congestion, which is passive and subconjunctival, and is dependent upon some impediment to the free exit of venous blood from the interior of the eye. In this form the surface of the sclerotic is traversed by distended and tortuous veins, full of dark-coloured blood, which may be seen to emerge from the eyeball through openings not very distant from the corneal margin, and to pursue their course backwards. They are chiefly met with in cases of chronic internal inflammation or of increased tension, and are constantly present in fully developed glaucoma. *See* CONJUNCTIVA.

Cornea.—The chief characteristics of the cornea are its uniform transparency and its smooth reflecting surface, which, as a convex mirror, affords an erect but diminutive image of the objects in front of it. In the healthy state, the transparency of the cornea allows us to see the fibrillation and the colours of the iris with perfect distinctness; but it does not follow, because these are concealed, or seen only imperfectly, that the transparency of the cornea is impaired. The iris may be veiled by turbidity of the aqueous humour, due to the presence of blood or of inflammatory products in the anterior chamber; and we then judge of the condition of the cornea by its smoothness and reflecting power, and by the presence or absence of vessels running upon it from the conjunctiva. On the other hand, when the cornea itself is turbid, the turbidity is at first seldom uniform over the whole surface, and the more transparent portions will often allow us to see the condition of the aqueous humour and iris.

Slight opacities of the cornea, and even foreign bodies, such as pieces of coal or iron, embedded in its surface, are liable to escape cursory observation by reason of the direction in which the light falls upon them, or because they resemble in colour the background of iris or pupil behind them. In order to obtain the best possible view of the cornea, the patient should be seated opposite a large window admitting plenty of daylight, but not exposed to the direct rays of the sun. The eye under inspection should not only be turned successively in various directions, but the surgeon should also vary his own point of view, and, in cases admitting of any doubt, should employ two convex lenses—one as a 'bull's-eye,' to concentrate light upon the parts observed, the other as a magnifier, with which to examine the illuminated surface. The same thing may often be advantageously done by lamplight, and is then called 'focal illumination.' Inspection of the cornea may show that some foreign body is embedded in it, or that its surface is more or less cloudy, or irregular in shape, or ulcerated, or marked by the cicatrices of former ulcers. It may also be the seat of circumscribed abscess, or of suppuration between its laminæ, or it may be traversed by blood-vessels, arranged sometimes as two crescents, encroaching upon its upper and lower margins, sometimes in a fasciculus running to some single point, sometimes distributed more or less evenly over its surface. All these are conditions to be carefully noted as elements in diagnosis and as guides to treatment.

Aqueous Humour.—The parts which come next under examination are the aqueous humour, the iris, the pupil, and the portion of the crystalline lens lying immediately behind it. In health, the aqueous humour is perfectly transparent; but it may be rendered turbid by the presence of early inflammatory products, of pus, or of blood. Inflammatory products may be evenly diffused throughout the fluid; but pus and blood, unless they fill the anterior chamber completely, will tend to gravitate towards its lower portion. In this position, pus may be mistaken for a purulent infiltration between the layers of the cornea itself; but such an error would usually imply a careless inspection. The upper boundary of an infiltration is, as a rule, irregular; while that of a collection of pus, unless so small in quantity as to be rendered crescentic by cohesion to the angle between the cornea and the iris, forms an even horizontal line, which may change its position when the head is laterally inclined.

Iris and Pupil.—When the cornea and the aqueous humour are both transparent, they allow the condition of the iris and pupil to be clearly seen. The chief characteristic of the healthy iris is its lustrous striated surface ; the chief characteristics of the healthy pupil are its circular outline and its free mobility. If the iris be dull or discoloured, or if the pupil be irregular in shape, or contracted, or sluggish, these are facts on which important inferences may be founded. The lustre of the iris speaks for itself, but the determination of the mobility of the pupil requires care and attention. A sluggish pupil will still dilate and contract in unison with its healthy fellow, although not to the same extent; and hence it is necessary to protect from variations of light the eye which is not being examined. For this purpose, it should be closed, and the closed lids should be covered by a towel or handkerchief, folded into a sufficient number of layers to exclude light entirely, and then applied gently but closely by the hand. The eye under examination should not be touched, but only shaded by the hand of the surgeon, so placed as to intercept light as much as possible, and then once and again quickly moved aside while the pupil is steadily watched. In a healthy eye so treated, the pupil rather slowly dilates under the shadow of the hand, and contracts much more quickly when the shadow is withdrawn. Before concluding the inspection, it is proper to direct the patient to turn the gaze alternately to some near and to some distant object; because, in the healthy state, the pupil contracts during the effort of accommodation, and dilates again, independently of illumination, as the accommodation effort is relaxed. In certain diseases of the nervous centres, this function is perverted ; and the pupil which varies under light may be stationary during accommodation, or *vice versâ.* In all cases the pupil should retain a circular outline while changing ; and its area, up to about the age of fifty, should be of a clear bright black. After fifty, the black is usually exchanged for a more or less grey or yellowish tint.

Under the influence of disease the iris may be dull, or visibly vascular, or studded by nodules of lymph; and the pupil may be sluggish, or altogether fixed, or irregular in outline, contracting and dilating only at certain parts of its circumference, and its area may be more or less occupied by inflammatory products. For the full determination of some of these conditions, and also in order to inspect the crystalline lens, it is often necessary to obtain dilatation of the pupil by the aid of a mydriatic ; and for the purpose of mere examination, the best which can be used is a solution containing one per cent. of homatropia hydrobromate in distilled water. The advantage of this preparation is that its action passes away within twenty-four hours, and hence does not entail the same degree of inconvenience as an application of atropia or of duboisia. A single drop of the solution, placed within the lower lid by means of a quill or a camel's-hair pencil, will usually produce dilatation in from twenty to thirty minutes ; and any adhesions or irregularities of outline will then be rendered conspicuous. When the pupil dilates completely, or with a near approach to completeness, it becomes possible, by the aid of focal illumination, to see deeply into the crystalline lens, and even to recognise morbid growths, or effusions of blood or lymph, lying behind it in the vitreous.

Crystalline Lens.—Opacities of the lens may generally be made out very clearly, their grey or brown colour contrasting with the natural aspect of the pupil. For the inspection of parts deeper than the iris, focal illumination is at best a method supplementary to the use of the ophthalmoscope, an instrument which is in most cases essential to a complete examination, and which will be the subject of a separate article. *See* OPHTHALMOSCOPY. But without the ophthalmoscope it is possible for anyone, who is acquainted with the anatomy of the eye and with the elements of pathology, to discover, by careful looking and by the exercise of common sense, what is the actual condition of all the more superficial parts of the organ. *See* CATARACT ; CRYSTALLINE LENS.

In order to examine these superficial parts completely, it is important that the patient should be able to assist the surgeon, not only by opening the eyes freely, but also by turning them in any required direction. There are some cases in which there is so much intolerance of light that the eyes can scarcely be opened at all, and in these it is necessary to resort to special expedients. A patient of sufficient age can often show the cornea by first directing the eyes towards the ground, and keeping them fixed in that direction, while the surgeon gently lifts the upper lid. With a child, if the difficulty arises as much from fear and unwillingness as from photophobia, the little patient may be made to sit on the knees of a seated attendant, and with his back turned to the surgeon, who must also be seated. The surgeon then lowers the child's body to a horizontal position, with the face upwards, and fixes the head firmly between his knees, while the attendant restrains the arms and legs. If the eyelids cannot then be sufficiently separated by the fingers, a metallic retractor may be slipped beneath the upper lid; and, if the eyeball is rolled upwards by the superior rectus, so as to conceal the cornea, a little chloroform may be administered. It is almost always better to have recourse to this expedient than to permit the nature of the affection to remain in doubt.

Tension of Eyeball.—In addition to the most careful inspection possible, it is often necessary to ascertain by palpation the degree of tension of the eyeball; since this is often of high importance and is liable to vary greatly in many diseased conditions. In order to estimate tension, the patient should be told to look downwards, closing the eyelids gently; and the surgeon should place the tips of his two forefingers just under the upper margin of the orbit, so that, through the intervening lid, they may rest upon the deepest part of the globe which is accessible. One finger-tip is then employed to steady the eye, while the other, by a gentle counter-pressure exerted and relaxed alternately, ascertains the degree of hardness. Under this manipulation, a healthy eye is felt to dimple a little, with a peculiar elastic resistance which is difficult to describe, but which the sense of touch soon learns to recognise, and for which the observer may usually take one of his own eyes as an approximate standard. The thinness, and consequently greater elasticity, of the sclera in children, in women, and in delicate persons generally, renders their eyes less resisting than those of adults, of men, and of the robust; and a certain degree of hardening is not unnatural in old age. Beyond the physiological limits tension may vary from a condition in which the eyeball is quite soft, so that its shape may be visibly altered by pressure, to a condition in which it feels as hard as stone. Such extremes are at once recognisable; and differences of opinion can arise only with regard to intermediate conditions. In cases which occasion doubt, it may be remembered that, as a general rule, the tension of the two eyes of the same individual will be alike originally, unless there is a congenital difference of refraction between them; and that abnormality of tension seldom proceeds with equal steps in both. A difference between the two eyes, therefore (and a very small difference may be recognised), should always be regarded with suspicion, and should at least lead to careful and repeated examination. Increased tension is generally associated with diminished acuity of vision (*see* VISUAL ACUITY), and also with contraction or modification of the field (*see* PERIMETRY), as well as by some displacement of the plane of the iris, by some sluggishness and often by dilatation of the pupil, and by diminished sensitiveness of the surface of the cornea. All these points will be fully discussed under the article GLAUCOMA, which see.

The diseases of the interior of the eyeball include those of the iris, of the crystalline lens, of the ciliary body and choroid, of the vitreous body, and of the optic disc and retina, all of which will be the subjects of special articles. For many of them, *see also* OPHTHALMOSCOPY.

PANOPHTHALMITIS.—The eyeball is liable to become the seat of general inflammation in various conditions of disease or injury. General inflammation, leading on, almost invariably, to suppuration, was a not very uncommon consequence of the method of cataract-extraction by the 'flap' operation, which has now fallen into disuse, and such inflammation is seldom seen after the employment of the more modern methods of procedure. It may follow any severe injury, either a contusion or a wound or rupture of the globe, and it is an occasional consequence of general pyæmic infection. The only treatment required, generally speaking, is to relieve painful distension by free incisions through the sclera, and, if the pain be not severe, nothing need be done beyond the use of such fomentations, or other soothing applications, as may be agreeable to the feelings of the patient. Inflammation of the eyeball, apart from the conditions in which it may originate, is seldom dangerous to life, although cases are recorded in which it has led to fatal meningitis, and, therefore, when an eye has been so severely injured that general inflammation may be expected, it is often desirable to perform enucleation early—to perform, in short, a primary amputation of the damaged organ, and thus to avoid suffering and danger. An eye should never be removed when in a state of actual or manifestly impending suppuration; and, after suppuration is completed, its removal is seldom necessary. The shrunken globe which is left behind often forms an excellent stump for an artificial eye, and seems to have no tendency to excite sympathetic mischief. On this account, Von Graefe proposed to excite suppuration artificially as a substitute for enucleation, by passing a seton through the eyeball in cases in which the conditions were such as to render sympathetic ophthalmitis probable.

The symptoms of panophthalmitis are scarcely liable to be mistaken. In the course of pyæmic infection, or after an injury, the eyeball becomes tense and hard, the lids and conjunctiva swollen, and vision is early abolished. If the cornea retains its transparency, pus may often be seen upon the iris, or in the pupil. In traumatic cases the pain is generally severe, but in those which originate in pyæmia it is little complained of. When pus or inflammatory products obtain a free outlet, either by perforation or by incision, the pain soon ceases, and, at the same time, the eyeball becomes soft, and the lid-swelling gradually subsides.

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EYEBALL, Excision of the.—Enucleation of the eyeball may be required on account of injury, especially to the ciliary body, or on account of the presence of a morbid growth. When the tunics of the eye are entire the operation is extremely simple, and the writer prefers what is called the 'Vienna method' of performing it. The patient being placed under an anæsthetic, a spring speculum is inserted between the lids and opened rather widely. The surgeon incises the conjunctiva, passes a strabismus-hook beneath the tendon of the internal rectus, and divides it, with the conjunctiva, at its insertion into the sclera. Seizing the stump of the tendon with forceps, he rotates the globe outwards, and, with scissors somewhat curved on the flat, divides the optic nerve. One blade of the scissors is then kept close to the eyeball within the wound, the other being external, and the blades are made to inclose and divide, at one stroke, the superior or inferior rectus with the conjunctiva covering it. The opposite muscle is divided in a similar manner, and the eyeball is lifted out of the orbit, a last touch of the scissors separating the external rectus, and any other tissues which may remain undivided. A pad of sponge should be instantly applied over the closed lids, and retained by a firmly-applied bandage, so as to compress the skin against the margin of the orbit, and to prevent leakage of blood into the subcutaneous tissue of the face. Unless this is carefully done, there is apt to be much temporary disfigurement from ecchymosis. After about four hours the tight bandage may be removed, and the subsequent dressing will only be to afford protection and to secure cleanliness. The muscles will fall together into a stump, and the wound will heal without trouble or delay. An artificial eye may be introduced in a fortnight or three weeks after the operation.

Another, but less expeditious method, is first to divide the conjunctiva just beyond the corneal circumference, then each of the four recti muscles separately on a strabismus-hook, then the optic nerve, and lastly the obliqui muscles with any remaining tissues.

When the eyeball is ruptured it can no longer be removed with the same facility, and must be dissected out with scissors as if it were a collapsed cyst, care being taken that none of the sclera is left behind.

In cases of injury, the optic nerve should be divided close to the eyeball, but, when the eye contains a tumour of possible malignancy, the division of the nerve should be at the apex of the orbit. Some surgeons advise the ordinary division, and that the rest of the nerve should be sought for and dissected out afterwards; but complete removal together with the eye is perfectly easy of accomplishment. The scissors used for this purpose may be straight, or curved very slightly on the flat, and should have sufficient length of blade to reach easily to the apex of the orbit.

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EYEBALL, Injuries of the.—Many of the injuries of the eyeball will be discussed under the heads of the structures respectively affected by them (*see* CORNEA, Inflammation of the; CONJUNCTIVA, Injuries of the; EYELIDS, Injuries of the); but others are of a more general character. Severe blows, as from a fist, a cricket-ball, or the cork of a champagne or soda-water bottle, may rupture the sclera, which generally yields at its thinnest part immediately behind the insertion of one of the recti muscles, may cause extrusion of the lens and prolapse of the iris, or even such hæmorrhage from the choroid as to detach the retina. In some instances, the lens has been driven through a scleral rent without rupture of the conjunctiva, and such injuries have been followed by good recovery. They should be treated by rest and cooling local applications until all risk of acute inflammation is over, and only when the scleral wound has had time for union should the conjunctiva be incised, and the lens removed from its new position. When the conjunctiva participates in the injury, no hope of preserving a useful eye can, generally speaking, be entertained, and it is better to perform enucleation at once than to wait for further symptoms. The same principle will apply to cases in which a foreign body, such as a shot-pellet or a piece of iron, is lodged within the eye, but the fact of such lodgment is often very difficult to determine. The writer has met with instances in which the eyeball has been struck, or even scored, by shot-pellets, which yet have not penetrated, but which have for a time totally destroyed vision by internal hæmorrhage. With a fragment of iron, the diagnosis can always be cleared up by the use of a powerful magnet, which will act upon the fragment in such a manner as to cause pain, and which may sometimes be used to extract it. With shot-pellets, the surgeon must form the best judgment he can from a careful examination of the eye and of all the circumstances of the case, and, when doubt exists, it will be most prudent to wait the course of events. When there is certainty that a foreign body has entered the eye, even if there be a chance that it has passed out at the other side and made a lodgment in the orbit, enucleation should be performed at once.

Small incised wounds of the sclera, such as may be produced by a sharp penknife, or by a splinter of glass, are seldom dangerous unless they fall into the region of the ciliary body, but they will often require a suture. The movements of the eye tend to make them gape, and the consequent leakage of vitreous humour both prevents union and produces and maintains diminished tension. Sometimes we may have direct penetration of the vitreous chamber, sometimes a small hernia of uninjured choroid through the wound. In the latter case, in applying a suture, the hernia should be replaced by a fine spatula, and held back while the needle is passed through. A small curved needle is the best implement for the purpose, armed with a thread of fine white silk. The suture should pass through the sclera on both sides of the incision, and the suture may be cut and removed in thirty-six hours or sooner.

R. Brudenell Carter.

EYELIDS, Diseases of the.—Hordeolum, or Sty, is an acute inflammation of the wall and circumfollicular tissue of a sebaceous gland associated with a ciliary follicle. The ciliary follicle may become secondarily involved, or inflammation of a ciliary follicle may provoke a sty. In all respects a sty is identical with a boil. It begins by localised pain, redness, and swelling at the edge of the lid. In a few hours the whole lid becomes œdematous, the bulbar conjunctiva becomes more or less red and swollen, and a muco-purulent discharge exudes from the palpebral fissure. At first sight the case may be mistaken for purulent ophthalmia. The edge of the lid is extremely tender, especially at a point corresponding with the focus of the disease. In a few hours suppuration takes place, the parts are then less tense, and matter presents around the lashes as well as on the anterior margin of the lid. If the case be left to itself the skin at the margin of the lid ulcerates, and the contents of the sty escape externally. The subjective symptoms then rapidly disappear, and the swelling gradually subsides. If the sty be opened the contents will be found to be a semi-globular mass of thick and tenacious pus. When the sty affects the inner angle of the lids, it may simulate a lacrymal abscess, and, indeed, it is sometimes at first impossible to make out whether the sac be implicated or not. Sties, like boils, are apt to recur.

The *causes* of a sty are general and local. The general causes are debility and depraved states of the system, anæmia, diabetes, uræmia, chronic constipation, functional derangement of the system, and indeed any or all of those conditions which precede or underlie the furunculous diathesis, &c. The local causes are irritation by dust, wind, impure air, insanitary conditions, badly-fitting spectacles, chronic conjunctivitis, ciliary blepharitis, catarrh of lacrymal sac or duct, &c.

The *pathology* is the same as that of furunculus or boil. The change probably begins as a circumglandular inflammation of a sebaceous gland. It never begins in the meshes of the tissues.

Treatment.—The local treatment may be abortive or curative. When the sty is first forming, it is often possible to arrest the inflammation by plucking the lashes from the ciliary follicles in the midst of the diseased area, so as to allow of the escape of the sero-pus that may have been exuded into or around the sebaceous and ciliary follicles. After epilation, either hot fomentations with water or a solution of belladonna extract should be used, or a solid stick of nitrate of silver, or a drop of pure carbolic acid, may be applied, or the follicle may be touched with the actual cautery. If the process have passed this primary stage, hot fomentations, or, if suppuration have begun, poultices may be used, and incisions should be made as soon as matter has formed. When the acute inflammation has subsided, astringent compresses, such as of lead, alum, or perchloride of mercury (gr. $\frac{1}{10}$ ad f℥j.), may be employed with benefit once or twice a day, and the edges of the lids kept softened with weak mercurial ointment—either the ammoniated mercury, or the yellow oxide, or the red oxide—each of a strength of about six to ten grains to an ounce. For the general treatment *see* BOILS.

MEIBOMIAN GLANDS. — Though these glands are embedded in the tarsus, which is of mesoblastic origin, the cellular elements of the glands are involutions of the epidermis, and, consequently, of epiblastic descent.

CHALAZION, OR TARSAL TUMOUR, is a neoplasm connected with the Meibomian glands, and not, as commonly believed, retained secretion of these glands. It partakes of the nature of a non-infecting granuloma. It seems to begin as chronic inflammation in the cellular tissue immediately around the wall of the Meibomian follicles, and as it increases in size it causes atrophy of the tarsus, and makes its way into the acini of the glands themselves. It occurs in two chief forms, one having its seat in the substance of the lid, forming a hemispherical body which may attain considerable size; the other situated at the margin of the lid around the duct of a Meibomian gland. Marginal chalazia are usually smaller and less circumscribed than those occurring in the substance of the lids. In either form it may last for months, or even for years, without undergoing much alteration in size or shape, but its tendency is to grow until at length it encroaches upon the cellular tissue and forms a swelling under the skin, or it may lead to softening and ulceration of the mucous membrane, and finally to perforation and protrusion of the growth into the conjunctival sac. Even after this it retains its vascular connexion with the lid and continues to elongate, and may project outside the palpebral aperture like a polypus. Rarely, the skin itself may ulcerate. If the chalazion grow rapidly it encroaches upon the adjacent glands, and may set up acute inflammation and suppuration in them, or the growth itself may suppurate. Occasionally it undergoes degenerative changes, or it may, rarely, disappear spontaneously.

On everting the lids, a reddish-brown or buff-coloured patch is seen on the mucous membrane, with perhaps a slight depression at the seat of the growth. It is at this point that incisions must be made for the removal.

A chalazion consists of numerous round, pale, and slightly granular cells of variable size, and usually containing a pale spherical or sphero-ovoid nucleus; it also contains many giant-cells. The cells are embedded in a pale gelatinous and slightly fibrillar matrix; and scattered throughout the mass is a network of capillaries, along the walls of which the cells of the growth congregate and collect into groups. These collections occur especially at the places where these capillaries divide.

Diagnosis.—When situated near the margin of the lid chalazion may be confounded with chronic ciliary blepharitis; and if it inflame and suppurate, it may be mistaken for acute ciliary blepharitis or for hordeolus. A diagnosis may easily be made by observing the precise seat of the greatest swelling and redness. In ciliary blepharitis and in hordeolus this is towards the free margin of the lids, and there is always more or less crusting around the lashes; whereas in inflamed chalazion, or abscess of the Meibomian glands, the redness and swelling are towards the inner margin of the lids, and the lashes are free from crusts.

Treatment.—When small, and not causing much disturbance or inconvenience, the growth may be left alone or treated by means of simple astringent and detergent applications. If large or unsightly, it is best dealt with by everting the lids and making a crucial incision at the buff-coloured spot, and then gently evacuating all the contents, either by means of pressure or by the introduction of a small scoop or curette. It is not necessary to apply any caustic afterwards with a view of destroying the wall. Incision through the skin, or excision of the growth, is seldom, if ever, advisable. For the inflammatory thickening that remains afterwards, mild astringent compresses, with a slight irritation of stimulating ointments over the skin, or a weak solution of iodine, are useful. It is well to tell the patient beforehand that after the removal of the growth the cavity fills with blood, so that immediately after the operation the swelling may even be larger than before. The blood is, however, absorbed in a few days. Marginal chalazia are more obstinate; if they irritate the eye or disfigure the lid, they may be incised vertically, and the contents broken up and removed by means of a broad needle or a 'spud.' With a view to prevent recurrences of chalazia, all causes of irritation and congestion of the lids must, as far as practicable, be removed. Errors of refraction and disorders of accommodation should be corrected by suitable lenses placed in properly fitting frames; using the eyes under unfavourable conditions of air, or light, or position should be discontinued, and the circulation of blood and lymph through the lids stimulated by means of douches, cold compresses, and gentle frictions with some form of weak mercurial ointment.

ABSCESS OF THE MEIBOMIAN GLAND is usually a suppurating chalazion, though it may be the result of inflammation around masses of retained excretion. The pus should be evacuated by incisions on the conjunctival surface. *See also* CONJUNCTIVA, Diseases of the.

CILIARY FOLLICLES AND EYELASHES.—The eyelashes are deeply embedded at the outer edge of the free margin of the lid. They are regularly shed and reproduced throughout life. According to the researches of Moll and Donders, each eyelash has an average period of evolution of about 100 days; and Unna has shown that little buds arise from the side of the follicles, and become themselves the sheaths of new lashes. These new lashes may take a different direction from the old ones, or may push the old ones out and assume their places. It is probable that a modification of this mode of generation may induce abnormalities of position of the lashes, or set up irritation or inflammation in the ciliary follicles.

CONGESTION OF THE CILIARY FOLLICLES. The ciliary follicles are not infrequently irritated and more or less swollen in persons having tender and delicate skin, or who have to use their eyes excessively or under unfavourable conditions, such as in crowded, ill-ventilated, ill-lighted, smoky or dusty rooms and workshops; or who wear badly fitting spectacles, or use improper lenses. Congestion of the edges of the lids, accompanied by an accumulation of fine bran-like crusts about the lashes, is a common concomitant of uncorrected errors of refraction, and especially of hypermetropia, with or without astigmatism. With this there is generally also some follicular conjunctivitis. While this form of congestion of the edges of the lids may primarily be dependent upon weak sight, it becomes in its turn a cause of asthenopia, and may by slight causes be excited into actual inflammation of the follicles.

Treatment.—The predisposing and exciting causes enumerated above must be diligently investigated and, as far as practicable, removed. Locally, mild alkaline or astringent lotions and a simple ointment, or some form of weak mercurial ointment, may be applied. In slight cases, boracic acid ointment is an elegant and agreeable application.

BLEPHARITIS CILIARIS, or inflammation of the ciliary follicles, is perhaps the commonest of diseases of the lids. It has been called by various names, some of which have reference to the appearances which the diseased lids present, others to various views of the nature of the pathology. The following are some of the commoner synonyms:—Belpharitis marginalis, lippitudo arida, psorophthalmia, tinea tarsi, ophthalmia tarsi, blear-eye.

The disease is an inflammation of the cellular tissue in and around the walls of the ciliary follicles. It is characterised by redness and swelling, together with the formation of papules, pustules, or ulcers at the margins of the lids. It may affect only one or two follicles, or it may involve all. It presents itself in one of three modes—either acute, sub-acute, or chronic; and there are three chief varieties—the simple inflammatory, the hypertrophic, and the suppurative or ulcerative.

(1). In *simple blepharitis* there are redness and swelling of the edges of the lids, involving the area occupied by the ciliary follicles. Only a few of the follicles may be affected, but more commonly the inflammation extends along the whole margin. Thin crusts form, under which are superficial excoriations, discharging ichorous fluid or actual pus. If neglected, simple blepharitis may develop into the more severe forms.

(2). The *hypertrophic* variety is characterised by great thickening of the edges of the lids. The margins of the lids are elevated, rounded, along the whole length of the tarsal border and for about from an eighth to a sixth of an inch of its breadth, embracing, in fact, the whole follicular area. The lashes gradually fall out or change their position. Even in this form there is some ulceration of the skin around the lashes, together with the formation of thin crusts.

As the fluid and cellular elements of the inflammation become absorbed cicatrization ensues, with displacement, inwards or outwards, of the edges of the lids and probable inversion of the lashes.

(3). The *ulcerative form* occurs especially in strumous persons. The inflammation is more intense, and of a lower type, and there is early suppuration and ulceration. Pustules and purulent crusts form at or round the base of the lashes.

Sequelæ.—The follicles may be so much damaged that they grow only ill-formed lashes, which are generally turned towards the eyeball (trichiasis); or they may be completely destroyed, so that they cease to grow lashes at all (madarosis); cicatrization may lead to eversion of the edges of the lids, and consequent displacement of the lacrymal puncta and overflowing of the tears; or it may lead to inversion of the edges of the lids and eyelashes (entropion and trichiasis); or it may induce contraction of the palpebral fissure (blepharophimosis). In some cases persistent thickening of the edges of the lid remains (tylosis).

The *Causes* are general or remote, and local: *general or remote*, struma, uterine diseases, sexual disturbances, constipation, &c. Some races seem to be especially prone to it, as the Jews. Among the *local* causes are occupations which necessitate exposure to impure atmosphere, whether the impurity be mechanical, chemical, or organic. The presence of morbid secretions of the adjoining glands may set up irritative septic changes in the ciliary follicles. Retention of fluids in the lacrymal sac and their consequent decomposition, chronic conjunctivitis, or the presence of vegetable fungi in or around the lashes, may be the exciting local causes. The disease may be, however, due primarily to errors of refraction, or to badly-fitting spectacles and *pince-nez.*

Pathology. — The disease begins by changes in the circumfollicular tissue, the follicle itself being implicated secondarily. The cells of the root-sheath and of the hair-root undergo retrogressive changes; and at length the structures at the base of the follicle may be destroyed.

Treatment.—Local: removing the hairs from the diseased follicles and the clipping off the rest facilitates the application of remedies, which should consist, in the first instance, of alkaline lotions to soften and detach the crusts and lessen the discharge, and then mild astringent compresses, such as perchloride of mercury (gr. ¼ ad f℥j.), lead, alum, zinc, &c. The skin should be protected by ointment, such as zinc, lead, or boracic acid ointment, or diluted ammoniated mercury (gr. v.–x. ad ℥j.), or Hebra's ointment. In the later stages, when all the inflammation has subsided, stimulating ointments, such as sulphur, tar, and oil of cade should be used.

The complications and concomitants of blepharitis marginalis must be treated according to the indications enumerated elsewhere.

In the hypertrophic form, repeated puncturings with a broad needle, and the subsequent application of the mitigated stick or of a strong solution of nitrate of silver (gr. xv.–xxx. ad f℥j.), may be of service. Where there is much ulceration, after the crusts have been removed, and the loose lashes pulled out and the others cut short, the exposed ulcers should be carefully painted with a solution of nitrate of silver, or a solution of perchloride of mercury (gr. ½ ad f℥j.). The lids should subsequently be bathed frequently with lead or boracic acid lotion, and ointment kept applied in the intervals.

Appropriate internal treatment should be used in addition to local remedies: cod-liver oil, arsenic, iron, quinine. The sulphides, the sulphites, and hyposulphites are among the most useful medicaments.

Trichiasis and Distichiasis.—Though each of these may occur independently of the other, they are commonly associated. By the term trichiasis is meant an irregular and disorderly growth of the eyelashes, some or all of which turn towards the eyeball; while by the term distichiasis (δίστιχος, with two rows), is meant a growth of an appreciable row of lashes within the normal row. The second row may be short and consist of only a few hairs, or it may be longer and extend along the greater portion of the edge of the lid. The lashes in trichiasis may present normal appearances, but frequently they are fine, almost colourless, and twisted, so that they may easily escape hasty observation.

These disorders are usually associated with incurvation of the lid or actual entropion, and in turn the irritation set up by the lashes increases the entropion by inducing spasm of the orbicularis.

Trichiasis and distichiasis sooner or later produce inflammation and ulceration of the cornea, which, if allowed to go on unchecked, may ultimately destroy the eye. The ulceration is often extremely obstinate, and indisposed to heal even after the primary cause of the irritation is removed.

Treatment. — Epilation always gives present ease, but it is at best a temporising expedient. More radical procedures are needed in order to secure permanent relief. The bulbs must be destroyed or excised, or transplanted. Electrolysis is the most effectual means of destroying the bulbs if only a few be affected. A needle attached to the negative pole of a battery is passed down the follicle, while the positive pole is placed on the temple. An eschar is produced and the bulb is destroyed. Excision is more suitable when more of the follicles are implicated, and when there is neither incurvation nor entropion. The edges of the lids being fixed in a clamp to prevent bleeding, an incision about one-sixth of an inch deep is made along the edge of the lids, just within the lashes to be removed. A similar incision is made in the skin outside the lashes. The intervening lashes and bulbs are then carefully and completely removed. Should any bulb escape, as indicated by the black point at the bottom of the wound, it must be separately removed.

Transplantation is generally reserved for those cases in which the trichiasis involves the whole length of the lid. The operation most commonly practised is that originally proposed by Jaesche, or some modification of it. The lid is split along the margin between the eyelashes and the Meibomian follicles. The intra-marginal incision should be about one-sixth of an inch deep, so as to extend beyond the follicles. When the row of lashes has by this means been freed, an elliptical piece of skin is removed from the surface of the lid. Sutures are then inserted, and the row of lashes drawn away from the margin of the lid. *See* also ENTROPION.

EMPHYSEMA is due to fracture of the nasal, frontal, or ethmoidal bones, with laceration of their mucous membranes. It is usually due to direct violence, though it may result from violent sneezing or blowing of the nose. After the laceration, the lids may suddenly puff up when a strong expiratory effort is made; the swelling having the peculiar crepitation so characteristic of the presence of air. As regards treatment, moderate pressure is all that is needed, and avoidance of anything like violent expiratory efforts, such as occur in blowing the nose, sneezing, or playing on a wind instrument.

Emphysema of the lids and orbit is very serious if associated with fracture of the skull.

ABSCESS OF THE LIDS declares itself by the cardinal signs of redness, heat, swelling, pain. The redness in severe cases is often extremely dusky. The bulbar conjunctiva may be injected and much swollen (chemosis). In the early stages, in addition to a general œdema of the lid there is a localised swelling, which is at first hard and tense, and often feels like a solid growth. The lids cannot be opened, and the appearances may resemble those of severe purulent ophthalmia. In a few hours softening and suppuration occur in the indurated mass. Occasionally, especially in delicate children, the distended skin may suddenly become gangrenous, and eventually is thrown off in a slough. Great cicatricial contraction may follow, with more or less eversion of the lids.

The *treatment* is that of abscess occurring in other parts of the body—hot fomentations in the early stages, poultices when pus begins to form, and evacuation of pus as soon as discovered. The incision should be made with a fine knife, and parallel with the fibres of the orbicularis muscle. A fine india-rubber drainage-tube may be inserted for a day or two, to ensure complete evacuation,

MUSCULAR AFFECTIONS. — In the lids there are two kinds of muscular fibre—the striated and the non-striated. The striated comprises the orbicularis muscle, supplied by the seventh nerve, and the elevator of the upper lid, supplied by a branch of the third nerve. The non-striated fibres, innervated by the sympathetic, are usually named after their discoverer, Müller, and are connected with the proximal borders of the two tarsi. Both sets of muscular tissue are liable to the diseases common to kindred tissues, the chief pathological states being spasm and paralysis.

ORBICULARIS MUSCLE.—*Spasm* occurs in two forms, the clonic and the tonic. (1) In the *clonic* form (nictitation), there is repeated twitching and winking of the lids. It is especially common in children who have errors of refraction. It is likewise associated with chorea, epilepsy, hysteria, or diseases dependent on central change. It may be due to overstraining of the eyes under unfavourable conditions, as bad light. In slighter forms it manifests itself as a quivering of the lid, popularly designated ‘live-blood.’

(2) *Blepharospasm*, or *tonic* contraction of the orbicularis, may be intermittent or continuous, lasting from a few seconds to some hours. It is usually intermittent at first, becoming continuous later on. In some cases it is so severe, and the spasm lasts so long, as to give rise to serious inconvenience and even to jeopardise the patient's life. A person may, for instance, be run over if seized with spasm while crossing a street.

In some cases the spasm may be arrested by pressure on one or other branches of the fifth nerve, the supra-orbital, infraorbital, temporal, malar, or mental. These are called 'pressure points.'

Causes.—Blepharospasm may be due to injury, disease, or irritation of the fifth or of the seventh nerve, from any cause whatever. Among the former may be reckoned foreign bodies on the cornea or in the conjunctival sac, wounds or inflammation of the cornea or conjunctiva, or ulcers of the cornea, and dental disorders. Gastro-intestinal disturbances may excite it, or it may be a symptom of a general neurosis, and is especially common as associated with facial tic. It may be due likewise to intracranial affections, especially at the base of the brain; or it may be dependent on diseases of the temporal bone, or on diseases outside the skull, as abscess of the parotid gland, &c. Or it may be due to syphilitic or rheumatic inflammation.

Treatment.—The first indication is to remove or correct the predisposing and exciting causes. The continuous current, faradic current, or blisters may be applied over the 'pressure points.' In obstinate cases section or excision of a portion of the nerve at the 'pressure point' may be tried. Division of the outer canthus of the lids is sometimes of service. Morphia, belladonna, or conium may be given internally. Eserine in doses of gr. $\frac{1}{60}$ to gr. $\frac{1}{15}$ is said to be a powerful remedy in blepharospasm. Later, tonics, as arsenic, phosphorus, strychnine, quinine, bromide or phosphide of zinc, iron, cod-liver oil, &c. *See* Facial Spasm.

Paralysis of the Orbicularis.—The prominent symptom is inability to close the lids (lagophthalmos). In addition there may be the other symptoms of facial paralysis—upraising of the eyebrow, and flattening of the corresponding cheek and nostril. Partly from the inaction of the lid and partly from the displacement of the edge of the lower lid, tears cannot get into the lacrymal punctum, and consequently overflow. In sleep, and in all attempts to close the lid, the cornea rolls upwards under the cover of the lid. Otherwise, the conjunctiva and cornea are constantly exposed, and are consequently liable to injuries from dust and other foreign bodies. There may be paralysis of all the other muscles supplied by the facial nerve, while the orbicular muscle escapes. On the other hand, this muscle is rarely paralysed alone. When recovery takes place in facial paralysis the orbicular muscle is one of the first to recover. Sometimes the external rectus is implicated in paralysis of the orbicularis. In such instances the lesion is probably situated in the pons varolii, or there may be hemiplegia of the opposite side. Sometimes the auditory nerve is also involved.

The *cause* may be injury or disease of, or pressure upon, any portion of the seventh nerve in its intracranial, temporal, or extracranial course, such as lesions in the pons, hæmorrhage, softening, meningitis, diseases or fracture of the temporal bone, wounds or other injury of the nerve outside the skull, or pressure of enlarged glands, nodes, &c. Syphilis and rheumatism are among the commonest predisposing causes, and a partial paralysis of the orbicular muscle occurs in true leprosy.

Treatment.—To obviate inflammation of the cornea and conjunctiva, the lids should be protected by means of a light pad smeared with boracic acid ointment. If this do not suffice, the edges of the lids should be pared and united by sutures. In addition, the treatment must be directed against the exciting and predisposing causes.

Levator Palpebræ Superioris.—*Spasm* of this muscle is rare. When it exists the eyelids cannot be closed either voluntarily or during sleep. It may depend upon direct injury or rheumatic irritation, or on reflex irritation of the fifth nerve, or, lastly, on central disease.

In *Paralysis of the Elevator* of the upper lid the most conspicuous symptom is drooping of the upper lid (ptosis). It may occur during intra-uterine life, at birth, or at any later period. If it exist at birth it may be the result of intra-uterine disease, or it may be the result of injury during parturition. In any case the paralysis may be partial or complete. When it is partial the lid can be raised to some extent; but when it is complete the lid hangs loose and motionless, is usually smooth, and slightly œdematous.

If the elevator muscle alone be affected, the movements of the eyeball are unimpaired; but not infrequently other branches of the third nerve are involved, so that when the lid is raised the eyeball is seen to lie towards the outer canthus, and the pupil to be semi-dilated. The movements of the globe inwards, upwards, and downwards may also be limited or entirely abolished. Ptosis is occasionally recurrent, though it may attack one side at one time and the opposite side at another.

Causes may be due to disease or injury of the third nerve, or of pressure upon it, either at the nucleus in the floor of the third ventricle, at any part along the course of the nerve at the base of the brain, in the sphenoidal fissure, or within the orbit.

Syphilis or rheumatism is a common constitutional cause.

Treatment.—As far as practicable, the constitutional and local predisposing and exciting causes should be discovered and removed. Iodide of potassium should be freely administered, and the continuous or the faradic current daily applied. If voluntary power to raise the lid do not return, the question will arise whether an operation should be performed or not. The answer will depend largely upon the presence or absence of paralysis of other muscles supplied by the third nerve. If the internal, superior, or inferior rectus be incurably paralysed, it will be inadvisable to correct the drooping of the lid, inasmuch as there will remain disturbing and distressing diplopia. If, however, the eyeball muscles be intact, an operation may be done. The simplest is the excision of an elliptical-shaped piece of skin and orbicularis muscle from the upper lid, so as to shorten the upper lid and enable the frontal muscle to draw it upwards. A subcutaneous suture may be inserted, so as to form a cicatricial band, by means of which the occipito-frontalis muscle can be made to act upon the lid.

ECTROPION and ENTROPION will be found under their respective headings.

ANKYLOBLEPHARON is the adhesion of the edges of the upper and lower lids. This may be partial or complete, and may result from disease of the edges of the lids, or (more commonly) from injury. The inner portion of the palpebral fissure is more frequently affected than the outer.

SYMBLEPHARON, or adhesion of the lid to the eyeball, is usually the result of burns by fire or chemical solids or fluids, but it may result from diphtheritic conjunctivitis. The adhesion may involve the whole extent of both lids, or it may be confined to a much smaller area ; it may affect only the sclerotic portion of the globe, leaving the cornea free, or it may occupy more or less of the cornea.

Symblepharon may be complicated with ankyloblepharon.

Treatment.—If there be only a narrow band of adhesion between the lid and the globe, it may be divided by scissors or by ligature : but if the adhesion be broader, this will not suffice, and the abnormal union must be severed by a more deliberate procedure. Transplantation in some form will be required, since reunion almost invariably takes place from mere division of the adhesion.

There are several modes of dealing with symblepharon ; but the management of particular cases must to a large extent be left to the skill of the surgeon. The transplantation of a portion of rabbit's conjunctiva has been recommended, and Stellwag has suggested the employment of a portion of mucous membrane from the lips or from the vagina.

A simple and effectual way of dealing with symblepharon of the lower lid is to dissect the cicatricial band from the globe, and then, by means of a suture inserted at the apex, to turn the flap downwards towards the *cul-de-sac*, and fix it there, by passing the suture through the substance of the lid and attaching the thread to a quill or piece of rubber drainage-tube. By this means the cuticular surface of the cicatricial band is turned to the globe, while the inner surface contracts adhesions to the dissected wound in the conjunctiva. J. TWEEDY.

EYELIDS, Injuries of the.—The principal injuries of the eyelids are bruises, wounds, and burns.

BRUISES of the eyelids are usually unimportant though disfiguring, unless they are the result of injury to the orbit or base of the skull.

WOUNDS of the eyelids may be incised, lacerated, contused, punctured, or poisoned. They may not only cause deformity of the lids, but may be followed by paralysis of one or other of the muscles. Even permanent blindness may supervene on wounds of the eyelids.

Incised, *lacerated*, and *contused* wounds may involve the whole thickness of the lids, or only the skin and subcutaneous tissues. If the lid be completely divided, the edges of the wound should be brought together as early as possible by means of fine sutures or a very fine harelip pin inserted close to the margin. If this is not done, the lips of the wound will gape and become everted through the action of the orbicularis. In lacerated wounds and in incised wounds whose lips have become everted, it may be necessary to pare the edges before bringing them together. In wounds involving the lower canaliculus, an opening into the lacrymal sac should be secured before bringing the lips of the wound together. Simple incised wounds only need accurate adjustment by fine silk or horsehair sutures.

Punctured wounds of the lids may be complicated by fracture of the orbital bones or by the intrusion of foreign matter into the cellular tissue of the orbit, or even into the cranium. The prognosis should be guarded, and the treatment to some extent expectant.

Poisoned wounds may be due to bites, scratches, or inoculations with virulent matter, vaccinal, syphilitic, &c.

Burns may present every degree of severity, from slight redness of the skin to complete destruction of both lids. Burns which at first may not seem very severe may, by cicatrization, lead to complete eversion of the lids. *See* Ectropion.

Adhesion of the margins of the lids (ankyloblepharon) or adhesion of the lids to the globe (symblepharon) may follow burns.

See also Conjunctiva, Injuries of the; Cornea, Inflammation of the, and more particularly *Abscess of the Lids, Ankyloblepharon, and Symblepharon* under Eyelids, Diseases of the; Ectropion. J. Tweedy.

F

FACE, Fracture of Bones of the.—In extensive injuries lines of fracture may traverse the facial bones in various directions. The fractures are often compound and comminuted, or depressed. In some cases the whole framework of the face has been separated from the skull as far back as the sphenoid. Hæmorrhage, at first copious, soon ceases. The accompanying wound must be thoroughly syringed with carbolic lotion (1 in 40); adjustment must be accomplished either by the fingers or by elevators; no fragment should be removed unless completely detached and loose; drainage, when necessary, must be provided for; and the soft parts must be very accurately brought together by fine sutures. Some surgeons cover the edges of the wound with collodion. Swelling may be limited by ice or evaporating lotions.

Serum must not be allowed to collect; to evacuate it, the edges of the wound should be separated by a director gently introduced. Union occurs very rapidly, but the opportunity of removing any remaining displacement must be carefully watched for as swelling subsides. When the fracture extends into the mouth, frequent syringing with Condy's fluid should be employed. The fragment may sometimes with advantage be wired together or supported by vulcanite plates, now so skilfully made by dental surgeons.

Nasal Bones.—Fracture is due to direct, often to great, violence. The fracture is generally towards the lower edge of the bones, often transverse and depressed, or the sutures may be opened. There is frequently, also, fracture of the nasal processes of the superior maxillæ, or of the lacrymals. The nasal bones have been driven up so as to fracture the cribriform plate of the ethmoid, and lead to injury of the brain. The septum may be fractured or deflected. It may, if swelling have ensued, be difficult to reduce, or even to detect, the fracture. Ice will tend to diminish œdema and check bleeding, which may be troublesome. If examination is resisted, or the patient is nervous, an anæsthetic may be given. Necrosis may result, but it is rare. For replacement, a stiff director or a pair of closed dressing-forceps may be introduced into the nose, while the fingers are used externally. The fragments will often remain in position. If not, it is better to replace them when they slip, than to introduce plugs. In a day or two they will, as repair advances very rapidly, become fixed. It has been suggested that a hare-lip pin should be passed transversely under the fragments to support them. In cases otherwise intractable this method may be tried; a very fine drill, however, must be used, and care must be taken not to disfigure the skin. Erichsen suggests an india-rubber bag distended after introduction, as used for epistaxis; Hamilton, small pledgets of medicated wool, supplied with numbered strings, so that they may be removed in the order of introduction. Should deformity remain, Adams advises the forcible adjustment of the bones by strong smooth-bladed forceps, and the use of a screw clamp—one blade in each nostril—to support the septum. This method may be tried in even old fractures in which there is marked deformity.

Superior Maxilla.—This bone may be fractured, but only by great violence, through either its nasal or alveolar process, the antrum may be driven in or the bone may be extensively comminuted. The intermaxillary or other sutures are sometimes opened. These fractures are often compound, and attended with profuse hæmorrhage, or associated with serious injuries of the brain, and a guarded prognosis should therefore be given. Subcutaneous emphysema is often observed, which, however, soon disappears.

Treatment.—Displacement must, if possible, be at once corrected, for even slight irregularity may produce great disfigurement.

Hamilton suggests that an elevator with a cutting thread may be screwed into any depressed fragment in order to raise it. When the alveolar process is fractured, the fragments may be steadied by wiring together the adjacent teeth.

Malar Bone.—Fracture of this bone is very rare, and is produced only by great violence. It is almost invariably associated with fracture of the upper jaw or other facial bones. If, in comminuted fracture, fragments are driven into the temporal muscle, they should be removed. Displacement, if considerable (it is usually slight), should be corrected, a small incision being, if necessary, made for the passage of an elevator. Fragments once replaced will usually remain in position.

Zygoma.—Fractures of this process are very rare. They occur (*a*) from direct violence; (*b*) in association with fracture of the malar or superior maxillary bones; or (*c*) when a foreign body is thrust outwards through the mouth. Displacement is usually slight, as the surrounding bony structures steady the fragments. If depression is marked, so as to interfere with the temporal muscle, a small incision may be made, through which to introduce an elevator. The accident has been followed by stiffness of the jaw. The injury which fractures the zygoma may produce concussion of the brain. These cases therefore require close watching.

Howard Marsh.

FACIAL ARTERY, The.—A branch of the external carotid, commences opposite the angle of the jaw and dips underneath the digastric and stylohyoid muscles to reach the submaxillary gland, from which it ascends over the lower jaw, two fingers' breadths in front of the angle. The artery then passes about three-quarters of an inch from the angle of the mouth up towards the nose and the inner angle of the orbit, where it ends.

Ligation.—The artery is tied, usually, as it crosses the jaw. Place the patient on the back, with a pillow below the neck; maintain the head at right angles to the neck, with the face looking towards the opposite side. Make an incision over the artery, the vessel being found, as stated above, two fingers' breadths in front of the angle, where it lies on the bone at the anterior border of the masseter muscle. The pulsations, however, are the best guide. The incision, one inch long, divides the skin, superficial fascia, platysma, infra-maxillary branch of the facial nerve, and the deep fascia. The artery is found lying on the bone, with the vein posterior to it. Pass the needle from behind forwards.

James Cantlie.

FACIAL CARBUNCLE. *See* Carbuncle.

FACIAL PALSY.—Paralysis of the muscles supplied by the facial nerve is a condition which occasionally comes under the notice of the surgeon. It may depend on a variety of causes:—first, central, including injuries or tumours of that part of the brain in which the cortical centres governing the muscles of the face are situated, or any other part through which the fibres are passing from this region to the facial nerve. Under this heading are also included the various general paralytic conditions which depend upon hæmorrhages, softening, and other causes, and belong more properly to the province of the physician. Secondly, intracranial tumours pressing upon the facial nerve in its course from the brain to the internal auditory meatus. Thirdly, injury to the nerve in its course through the temporal bone. This may arise from fracture of the skull, and may set in immediately after the accident, or at a subsequent period when the nerve is pressed upon by the new material thrown out in the course of repair of the bone. It should be borne in mind that the temporal bone may be broken without involving a genuine fracture of the skull. The more common cause of damage to the facial nerve in the bone is, however, the existence of suppuration in the middle ear and consequent invasion of the aqueductus fallopii. This condition is sometimes met with in the adult, and not very infrequently in children it is one of the causes of that very distressing condition, double facial palsy. Fourthly, damage to the nerve after it has left the stylo-mastoid foramen. This may arise simply from exposure to cold, or from accidental or intentional wounds of the face, the latter including division of the nerve, or of some part of it, in the course of the removal of tumours, the opening of abscesses, operations on the lower jaw, and other surgical procedures.

The characteristic appearance of a patient with facial paralysis need not be here described, but one sequela must be mentioned. The eyelids can, of course, be only imperfectly closed, though some slight movement of the upper lid usually, if not always, remains; the patient is thus obliged to effect the purposes of winking by turning the eye upwards, and an occasional result of the inadequate cleansing of the surface of the eyeball is the onset of conjunctivitis; and if the fifth nerve be also paralysed so that sensation is abolished, sloughing of the cornea may result. To prevent this, it is sometimes necessary or advisable to stitch the margins of the lids together, after paring them, leaving only a small aperture in the centre of the ocular slit for vision, or the lids may be fastened together by a strip of plaster or other means.

No surgical treatment can be carried out for facial palsy beyond the application of blisters over the course of the nerve, with the object of accelerating the cure of the simple 'rheumatic' or peripheral variety. It is conceivable that cases may arise in which it might be possible to stitch together the ends of the divided nerve, but it is not known that this method has ever been put in practice.

Rickman John Godlee.

FACIAL SPASM (Tic Convulsif).—Spasm of the facial muscles varies very much in degree, and no doubt also very much in its cause. The simplest forms are such as the mild and transient twitching of the orbicularis palpebrarum, which is often associated with, and probably dependent upon, rectal irritation, or some other trivial cause; or the slight jerking of the corner of the mouth, or winking of the eyelid, which is apparently little more than a habit or trick which has become second nature. The most severe form is that in which all the muscles of one side, or of the whole face, are in a perpetual state of involuntary movement; the movements, though for the most part painless, being a source of intense and wearying annoyance to the patient, and sometimes only intermitting during sleep. Between these two extremes all sorts of varieties are met with.

As to causation but little can be said. Some are apparently what may be indefinitely called hysterical affections; some appear to depend upon reflex irritation, such as the presence of carious teeth, or the existence of wax, or other mischief, in the ear, or of some disease of the eye; others, again, depend undoubtedly upon some cerebral lesion, though we are without data as to the nature of the lesion, and *a fortiori* as to its seat, but it may be assumed to be in some cases cortical and in others central. In one case, in which a post-mortem examination was made, an aneurism of the basilar artery pressing upon the facial nerve was found, but this can only be looked upon as a pathological curiosity.

In many cases the spasm is made worse by excitement, impairment of the general health, and exposure to the influence of cold winds or bright lights, while it is allayed by the opposite conditions; and in most, if not in all, the amount of twitching varies from time to time. In a severe case, affecting both sides, the eyes may be so completely closed at times that the patient is unable to see, while his head is being constantly bent forwards by the powerful contractions of the platysmata, and the angles of the mouth are being frequently drawn downwards and outwards into an ever-varying 'risus sardonicus.' Many cases are accompanied by painful affections of one or more branches of the fifth nerve.

Spasm of the facial muscles occurs in the course of other more general convulsive diseases; but these lie outside of the present subject. Closely related to 'tic convulsif' is the condition known as spasmodic torticollis, in which the spinal accessory nerve is sometimes apparently alone affected, though often a whole physiological group of muscles is affected by the movements, some being on one side of the body and some on the other—a sternomastoid, for example, acting with the opposite splenius.

The treatment of facial spasm involves a careful inquiry into the general health, and a minute search for, and, if practicable, removal of, all sources of possible reflex irritation. Galvanism appears to have been useful in a certain number of cases; and many others have in time disappeared spontaneously, not infrequently after they have resisted all known methods of treatment. The question of stretching the facial nerve has been carefully considered and several times put in practice; it appeared at one time to produce very encouraging results, for almost all the earlier cases were described as being relieved or cured. The reports were, however, published too soon. The writer, who has performed the operation on two patients, collected the statistics of all the cases published up to June, 1883, which showed that, in all but one, recurrence of the disease had taken place, although several patients had experienced a more or less prolonged relief from the troublesome symptoms. In one of his own patients the twitching returned some months after the operation, but a spontaneous cure subsequently occurred.

If the operation be decided upon, a curved incision should be made immediately below the attachment of the lobule of the ear, and another from the centre of this downwards for two inches along the edge of the sternomastoid; the parotid gland is then to be separated from the sterno-mastoid, and the latter drawn back with a hook till the posterior belly of the digastric appears. Immediately above the upper border of this muscle the nerve may be easily found in its short course between the stylo-mastoid foramen and the gland. It is then to be forcibly stretched over a hook. This method of stretching a small nerve, like the facial, is a totally different process from that of pulling a large nerve, like the sciatic, out of its bed with the finger. It involves a partial destruction of the nerve at the point stretched, and a consequent total paralysis of the nerve beyond; but it also involves the certainty of the re-establishment of the conducting power of the nerve. While the nerve is paralysed the twitching is, of course, in abeyance, but in the course of from six weeks to three months the nerve regains its function, and at a variable time after this has occurred, in most cases in which the treatment has been adopted, the spasm has gradually redeveloped itself.

The patient may have six months' respite, or even longer, and in recommending the operation this must be put before him, as well as the fact that only one case, at the present time, remains, so far as is known, cured. The only other available surgical treatment is the division of the nerve; this unquestionably relieves the patient of his trouble for ever, but substitutes the not insignificant inconvenience of permanent facial palsy, and deprives him of the possible chance of a spontaneous cure.

Rickman John Godlee.

FÆCAL ABSCESS and FÆCAL FISTULA.—A fæcal abscess is one which communicates with the interior of the intestine. The pus from such an abscess will have a fæcal odour and contain fæcal matter. Pus from an abscess may have a distinctly fæcal smell, without being in communication with the intestine, without being, in fact, according to the above definition, a fæcal abscess. Thus, suppurative collections which are in close contact with the intestine, and especially with the colon, often acquire a most offensive fæculent odour, although they have at no time communicated with the gut, and contain no fæcal matter.

Fæcal abscesses form, as a rule, in one of two ways. By one method an abscess develops outside a normal segment of the bowel. In process of time it makes its way through the wall of the bowel, pus enters the gut, and fæcal matter the suppurating cavity. Thus perinephritic and iliac abscesses, purulent collections following pelvic cellulitis, and even abscesses arising from caries of the spine, have opened up some part of the ascending or descending colon, or of the cæcum. In the other class of case the bowel is perforated as a result of ulceration, gangrene or wound, the perforation is behind the peritoneum, the intestinal contents escape into the subserous tissue, and an abscess is set up. The perforation may in some cases be upon the peritoneal aspect of the bowel, and the extravasation be limited by extensive peritoneal adhesions.

The second form of fæcal abscess is the more common of the two. It is most frequently met with in the vicinity of the cæcum, as a result of ulceration of the cæcum or appendix, or of typhlitis. Foreign bodies which have become impacted in the bowel are not infrequently discharged by means of a fæcal abscess.

The fæcal abscess is apt to spread and produce grave symptoms. It may burrow among the abdominal muscles or extend down into the pelvis. It may open through the skin, or in rarer instances into the bladder or vagina, or even into some remote part of the intestinal canal. There is, therefore, scarcely any form of abscess which requires more active treatment, and which demands more early incision. The moment the condition is diagnosed, the suppurating collection should be evacuated by the freest possible incision, and the abscess-cavity well washed out with some antiseptic solution. The condition usually passes on to that of fæcal fistula.

The term *Fæcal Fistula* is applied to a fistula that communicates with the cavity of the bowel on the one hand, and with the integumentary surface of the body on the other. The species of abnormal opening to which this term is limited, and the arbitrary distinctions established between fæcal fistula and artificial anus, are alluded to in the account of the last-named condition.

A fæcal fistula is most usually the result of a fæcal abscess which has effected an opening through the integument. It may, however, result directly from deep, penetrating wounds and gunshot injuries, which have produced an opening in the bowel at some distance from the surface of the body. In the present form of fistula, the bowel opens indirectly upon the surface. A fistulous track intervenes between the hole in the intestine and the hole in the skin. This track is usually narrow, and is very often tortuous and most irregular. It may be interrupted by a large abscess-cavity which contains both fæcal matter and pus, and discharges both at its integumentary orifice. To fistulæ which present conspicuously this mixed discharge, the term 'sterco-purulent' has been applied.

As a rule there is only one aperture in the skin, although there may be several openings into the gut. The amount of fæcal discharge varies, and is usually comparatively slight.

The serious element in the prognosis of fæcal fistula depends, not so much upon the premature discharge of the intestinal contents, as upon the fistulous track or abscess-cavity which intervenes between the involved bowel and the skin. The patient may die from exhaustion following the prolonged suppuration from the cavity of the abscess. The pus may burrow, may greatly undermine the skin, may penetrate between the layers of the abdominal muscles, may enter the pelvis, and may in this way produce an extensive area of inflammatory disease which in time exhausts the patient's strength. The pus in such cases is necessarily very foul, and erysipelas and pyæmia are not uncommon sequelæ of the condition.

The general treatment of examples of fæcal fistula consists in supporting the patient's strength, in keeping the bowels in good order so that their action is not too sluggish on the one hand nor too vigorous on the other, and in enjoining a careful diet composed of the most digestible forms of food.

As regards local treatment, the first and most important consideration is to provide a free discharge for all pus and fœtid accumulations. When an abscess-cavity exists, it should be very freely opened up, and thoroughly washed out with an antiseptic solution. It should be very frequently irrigated so that no matter be allowed to collect, and some antiseptic substance, such as iodoform or salicylic acid, should be kept constantly applied to the abscess-wall. When the escape of fæcal matter is slight, the cavity may be plugged by a material which will absorb the discharge as it escapes, while it will exercise at the same time an antiseptic effect upon the lining membrane of the cavity. For this purpose a sponge may be used, which—when dry—has been well impregnated with iodoform powder or salicylic acid. The sponge, or such other material as is used, must be very frequently withdrawn and replaced by a clean plug. Wood-wool will answer the purpose, or 'tenax,' or absorbent cotton-wool. Fistulous tracks should be opened up when possible, or dilated with a laminaria tent, or cut through with the elastic ligature when the knife seems inadmissible.

FREDERICK TREVES.

FÆCAL RETENTION. *See* INTESTINAL OBSTRUCTION.

FALLOPIAN TUBES, Diseases of the.—The Fallopian tubes are liable to stricture, to accumulation of serum (hydro-salpinx), of pus (pyosalpinx), or of blood (hæmato-salpinx), and to papillomatous disease of their lining membrane.

Stricture may arise from metritis, endometritis, or implantation of the placenta over the uterine end of the tube. It may merely cause obliteration of the uterine outlet, or it may close the tube at both extremities, and serum, pus, or blood accumulating in the tube, either of the three conditions named above may result. Gonorrhœa is said to be the commonest cause of pyosalpinx. Papilloma may either grow in an open tube, projecting into the peritoneum and setting up ascites, or it may grow in a tube already closed by inflammation. In the latter case a tumour will be formed, very difficult or impossible to diagnose from hydro- pyo- or hæmato-salpinx, or from tubal pregnancy.

A small hydro-salpinx is occasionally met with in performing ovariotomy. It may give rise to pain from spasmodic contractions of the tube, but more often gives rise to no symptoms, and is cured by reabsorption of the fluid, or by its escape either into the uterus or peritoneum. More rarely a tumour of considerable size is formed, and it may then be recognised as a sausage-like swelling in the pelvis, or as a cyst rising into the abdomen. In such a case its removal by abdominal section is justifiable.

Pyo-salpinx is a more serious condition, but is frequently cured spontaneously, by discharge of its contents through the uterus. It may, however, rupture into the peritoneum, and this is a very grave accident, and likely to cause fatal purulent peritonitis. A large pyo-salpinx may be diagnosed and removed in the same way as a hydro-salpinx; and the same rules apply to hæmato-salpinx or a papillomatous tube. It is impossible to formulate any rules for the differential diagnosis of these various pathological conditions.

Salpingotomy, the operation for their removal, differs but little from the operation of ovariotomy, and reference should be made to the full description given of that operation, for position of patient, instruments necessary, &c. *See* OVARIOTOMY.

It may be impossible to remove the distended tubes without some of their contents being spilt into the peritoneum; and, whenever this happens, the most careful and thorough sponging is necessary, for we can never be sure that the contents do not contain the causes of putrefaction. If it be a clear limpid fluid from a hydro-salpinx, careful sponging alone is necessary; but if pus or blood be spilt it will be advisable to introduce a Keith's glass tube. It is sometimes impossible to cut the uterine end of the tube through the strictured part, and a portion of the previously distended tube is left in the stump. When this happens, this portion of the tube should be thoroughly disinfected with pure tincture of iodine, and a drainage-tube should be used.

In most cases the ovaries are also diseased, or are so matted to the tubes by adhesions that their separation from them is impossible; but in other cases they are quite healthy and free, and may be left behind; the patient then continues to menstruate regularly, and suffers no inconvenience from the rupture of the follicles into the peritoneum. It is possible that in such a case the uterine stump of the tube might become patent again, and extra-uterine fœtation result; but this is very improbable, as the stump is usually very completely closed by the peritoneum growing over its raw surface. J. Knowsley Thornton.

FALSE JOINT. *See* Ununited Fracture.

FARCY. *See* Glanders.

FASCIA, PALMAR, Contraction of the. *See* Dupuytren's Contraction.

FASCIA, PLANTAR, Contraction of the. *See* Plantar Fascia, Contraction of the.

FAT-EMBOLISM.— The accumulation of fluid fat in the capillaries, consequent on extensive laceration of adipose tissue.

Causes and Pathology.—The process may be induced by any injury involving laceration of adipose tissue, its occurrence being favoured by increased tension in the region of the injury, and the presence of open vessels for the absorption of the free oil-globules. The latter enter the circulation chiefly by the blood-vessels, in part by the lymphatic system. The most favourable conditions for fat-embolism are presented in injuries to bone, the laceration of the medulla setting free large quantities of fluid fat, while the vessels are held open by their connections with the bony walls containing them. The tension consequent on blood-extravasation is another factor in its production, but not a necessary one, since the process frequently takes place in open fractures, and has been noticed in excisions and amputations. Fat-embolism is not uncommon after rupture of the liver or extensive subcutaneous injuries. It also occurs in acute osteo-myelitis, and is present in cases of diabetic coma. The fat collects in largest quantity in the pulmonary capillaries, to a lesser degree in the other organs. The fatal issue has been ascribed to the pulmonary obstruction alone, or regarded as due to the cerebral disturbance due to obstruction of the capillaries of the brain. The latter cannot be the cause of death in all cases, since in many the demonstration of extensive fat-embolism in the brain has not succeeded. Fat-embolism, in varying extent, seems to follow all fractures of bone, serious symptoms occurring in few cases only. Excretion of the fat is said to be effected by the kidneys. This does not commence at once, fat being usually not demonstrable in the urine prior to the third day, and then it does not proceed continuously, but often on two or three occasions with intervals of several days.

Symptoms.—The symptoms closely resemble those of collapse, accompanied by signs of acute pulmonary œdema. Their advent generally commences after the first twenty-four hours, usually after the patient has recovered from the primary shock of the accident. They consist in pallor, often with cyanosed lips, general muscular weakness, lowering of the bodily temperature, slow weak pulse, gradually becoming imperceptible, and respiratory embarrassment. In some cases extreme dyspnœa is observed, in others the shallow nature of the respiration is its chief peculiarity. General moist râles are to be heard throughout the chest; bloody expectoration has been noted. When the patient survives some days, oil-globules may be detected in the urine.

Diagnosis.—This may need to be made from shock, and from pulmonary embolism of the ordinary nature. In both, the period of occurrence is of importance, an interval usually intervening between the accident and signs of fatty embolism, while embolism from detachment of part of a venous thrombus is usually a much later complication than fat-embolism. The presence of oil-globules in the urine may be a useful diagnostic aid.

Prognosis. —This depends chiefly on the intensity and persistence of the symptoms; patients readily recover from the slighter degrees.

Treatment.—No specific treatment has been discovered. The ordinary treatment of shock may be supplemented by artificial respiration. G. H. MAKINS.

FATTY DEGENERATION is a pathological change which protoplasm may undergo, resulting in its conversion into fat.

Pathology.—It is well known from very many examples, which need not be repeated here but may be found shortly tabulated in text-books of physiology, that in the healthy body fat is continually being manufactured, as it were, by special corpuscles from the albumin and fat in the blood. Further, there is a great deal of evidence to show that fat as such is simply produced by metamorphosis of the proteid protoplasm of many corpuscles. It is this metamorphosis which reaches such a height in disease, and which then goes by the name of *fatty degeneration.*

Passing notice must here be devoted to the term *fatty infiltration.* By this expression two things are commonly understood—firstly, that corpuscles take up small globules of fat, as such, so that their protoplasm becomes crowded with fat-droplets; and, secondly, that the proper tissue-elements of a part are separated and pressed upon by ingrowth between them of adipose tissue. The latter of these conditions can be put aside at once, as foreign to the present subject; but true fatty infiltration, as contrasted with fatty degeneration, claims immediate attention. As described below, when we find an organ so fatty, by reason of its cells containing quantities of fat-particles, as justly to be considered pathologically altered, it is obviously an open question whether the protoplasm of the corpuscles is simply laden with accumulated fat brought to it as such (or in some preliminary form), or whether the proteid protoplasm is being converted into fat-droplets. Fatty infiltration, therefore, might be better termed fatty accumulation, and, accepting this view, we may examine the possible sources of the fat which a tissue may contain.

Accumulation.—(*a*) From fatty food; (*b*) from proteid food, e.g. the secretion of milk on flesh diet; (*c*) from carbohydrates.

Degeneration.— (*d*) from proteid protoplasm.

We need not here refer at further length to fatty accumulation, except to point out that this extremely simple process may be supposed to go on most readily in the liver and heart, which organs are most favourably placed for first receiving blood containing fat, as such, in a particulate state; and, further, that this clogging of the tissue-elements will tend to occur in those persons in whom oxidation-processes are sluggish and who lead an enervating life.

After these prefatory remarks, the causation of true fatty degeneration of protoplasm may now be discussed.

Etiology and Causation.—Fatty degeneration is now looked upon as a splitting of the proteid molecule into two unequal parts—one nitrogenous, and the other non-nitrogenous; thus:—

PROTEID—*Nitrogenous*: terminating by further disintegration in *urea*, &c. *Non-nitrogenous* : terminating by further disintegration in fatty acids, &c.

An extreme instance of this disintegration is found in the formation of adipocere, or corpse-wax, as the Germans call it, which, according to Hoppe-Seyler, is simply a mixture of calcic palmitate and calcic stearate—the non-nitrogenous side of the protoplasmic proteid, the nitrogenous bodies having been mainly given off as compound ammonias. It is a similar change which is produced in the body as a result of disease, under circumstances to be mentioned immediately, and in which case the urea excreted by the kidneys is found experimentally to be greatly increased.

This state of things is produced most easily by poisoning with phosphorus, alcohol, arsenic, bismuth, antimony, chloroform, ether, iodoform, carbonic oxide, chromic acid, sulphuric acid, and nitric acid; by the action of febrile pyrexia, or the poison causing the same; by (experimental) continued exposure to a heated atmosphere; and as a consequence of many cachectic states, and more especially the condition produced by pernicious anæmia, and that which leads to acute atrophy of the liver. It will be seen at once that these reagents, and poisons of uncertain nature, all act powerfully on the blood-corpuscles; and it has been assumed, with some show of reason, that they owe their power of producing this lesion to their destructive influence on the red-blood corpuscles. Whether this be so or not, there can be no doubt that one factor in the disintegration of the protoplasm of the affected tissue is defective oxidation. The *rôle* played by oxidation in reducing fatty accumulation is of course obvious, and for the reason just given it is probable that the lack of the same process causes the fatty metamorphosis of originally healthy corpuscles. At the same time it is to be remembered that in many instances where fatty degeneration follows the cutting off of the blood-supply to the part the loss is not only of the oxygen-carriers, but also of all the nutritive constituents of the blood. Moreover, fatty degeneration follows on loss of function simply, and where the oxidation and circulatory processes are not directly interfered with. Such instances are fatty degeneration of muscles which move joints that have become ankylosed, and others whose motor nerve has been injured.

Pathological Anatomy.—Macroscopically, the part affected is usually enlarged, with a smooth surface, and rounded outline; it is soft, cutting easily and smoothly, may be greasy to the feel, and smears the blade of the knife. Although the specific gravity is frequently very much reduced, still the defective oxidation, &c., leads to the accumulation of so many waste products that the organ is usually heavier than normal. The colour, pale in early stages, becomes gradually more and more yellow, until in a severe case it is of a bright yellow tint, which in some instances, such as in extreme cirrhosis, becomes orange. In a very advanced state the organ may have a nauseous oily odour.

Microscopically, the corpuscles of the organ or tissue affected are found to be slightly swollen and excessively granular. The granules are of various sizes and brightly refracting. In many corpuscles small oil-globules may have already formed, and, as such degenerated corpuscles frequently rupture in the preparation of specimens, the fatty particles and globules will be found effused into the surrounding tissues. The so-called compound granular corpuscles of Gluge are nothing more than collections of such fat-particles, and occur most frequently in the nerve-centres.

Virchow attempted to lay down, as a means of microscopical diagnosis, the dictum that when the fat was visible as fine granules it was the product of fatty degeneration or metamorphosis; but that when it was present in comparatively large droplets, it was then a result of accumulation or infiltration. This distinction, although partly true, is by no means absolutely so, since in many cases of acute fatty change from poisoning, and in the acute fatty degeneration of new-born infants (probably the result of a septic poison), the result is seen as large oily droplets in the corpuscles.

The subsequent changes in such an affected tissue are simply those of disintegration. Fatty degeneration, when it is a result of cutting off of the blood-supply to a part, assumes the special form known as caseation, and as such occurs frequently in infarcts, tubercular nodules, chronic abscesses, &c. In this condition of things the protoplasm of the corpuscles affected becomes cloudy and coarsely granular; the elements then fuse together so as to form an amorphous mass, which is of a dirty pale yellow colour, usually soft and pulpy, sometimes hard and tough from the coincident development of fibrous tissue in the part affected, and sometimes calcified.

Fatty degeneration may be best detected by examination of the fresh unstained tissue (1) in water, (2) in glycerine, when the fat-droplets show strongly by being highly refracting; (3) by treating the tissue with ether, when the fat particles are dissolved out, and (4) by prolonged staining with osmic acid, 1 p.c., and subsequent immersion for twenty-four hours in equal parts of alcohol and water; weak solutions of osmic acid are often powerless.

Symptomatology.—The symptoms of fatty degeneration are of importance to the practical surgeon in two ways, especially (1) as to a patient being in a fit state to undergo an operation; and (2) a patient's ability to take an anæsthetic. The symptoms of this condition will be best grouped under the headings of the different organs specially liable to be affected, and which possess the most practical bearing on the above points.

Heart.—A fatty heart is known by a tendency to, or actual attacks of, syncope; breathlessness on exertion; and occasional attacks of dyspnœa if the health be depressed in other ways. The pulse is usually feeble in severe cases, irregular, and easily quickened; and similar evidence is afforded by physical examination, which shows a weak impulse, and at the same time the heart's sounds are distant and indistinct.

Liver.—The organ is enlarged and may cause breathlessness mechanically, constipation of a mild and irregular degree, pale stools, anorexia, and in extreme cases dyspepsia.

Kidney.—Although an important condition, the fatty degeneration of this organ presents few special symptoms beyond diminution in the excretion of urine, and occasionally fatty débris in that fluid; so that diagnosis must rest upon the signs of a similar change in other organs of the body.

Prognosis.—Unfavourable, according to the progress of the degeneration.

Treatment must clearly be directed to the two points of (1) ensuring oxidation of the tissues without overwork and exhaustion, and (2) encouraging activity of visceral function and aiding excretion of all waste-products. The first can be obtained by prolonged moderate exercise in the open air, by the sea or on moors, &c., by driving, and possibly by the compressed air bath; while the second can only be reached by administering ordinary tonics, such as iron and quinine, &c., while the action of the different organs (especially the skin) and the activity of the circulation can be encouraged by the very moderate use of Turkish or vapour baths, coupled with gentle, prolonged shampooing, graduated to the strength of the patient, so as not to cause fatigue. But the best therapeutical agency, no doubt, is out-of-door life and very moderate exercise. VICTOR HORSLEY.

FATTY TUMOURS. *See* LIPOMA.

FAVUS (Tinea Favosa).—*Definition.* A contagious chronic disease of the skin caused by the growth of a fungus.

Symptoms.—Among the several skin-diseases produced by a fungus, favus is the most severe, by reason of the length of time it lasts and the great amount of permanent damage done to the skin. All regions of the body are subject to attack, but especially the scalp. Like ringworm, favus shows itself first as a small erythematous spot, which gradually spreads in the form of a ring, and in a few days becomes covered with crusts which almost immediately assume the characteristic cup-shaped form. In these early stages there is some itching, but this gradually subsides. When the disease attacks the head, the few hairs that pierce the cup will become dull in appearance and easily fall out. The cups themselves are yellow or sulphur-coloured, and, if the eruption is at all extensive or of long duration, emit a mouse-like odour which is one of the distinctive features of the disease. They are more or less firmly attached to the skin, and are difficult to remove, and leave pits. In long-standing cases the pressure of the cups causes atrophy of the skin, so that it is not uncommon for favus of the head to produce complete baldness, and the hair, once destroyed in this way, does not usually grow again. The cups vary in size from that of a pin's head to that of a split bean. On removal they will be found to be very brittle and dry, breaking up into powder, which, when placed under the microscope, is seen to be largely made up of fungus. Sometimes there is suppuration round the crusts, the dried pus mixing with the cups and altering their appearance. The disease, which usually attacks the poorer classes, is rare in England and the United States, common on the Continent, and also in Scotland, though not so common as it was formerly. It is contagious, but not so much so as ringworm, and has been known to be communicated by mice, dogs, and cats.

Diagnosis.—In the early stage favus may be mistaken for either simple erythema or ringworm; but when the crusts form the diagnosis is easy. It may also be distinguished from eczema and psoriasis by the cup-shape and yellowness of the crusts, and by the fungus found on microscopical examination. Favus of the scalp may also be erroneously taken for eczema, psoriasis, seborrhœa, contagious impetigo, pustular syphilide, or tinea tonsurans; but there are many points of difference. In eczema the surface is often moist; the redness shades off into healthy skin; the scabs are not cup-shaped or yellow; the hair often falls out, but it does not lose its lustre and permanent baldness is never produced; and, lastly, eczema is not contagious. Psoriasis, again, is distinguishable by the silvery whiteness of the scales, by the fact that the disease usually attacks other parts of the body, such as the tips of the elbows and fronts of the knees, and when the head is the part assailed the hairs are but slightly affected. In seborrhœa oleosa the crusts are more or less oily; the hairs fall out, but there is no fungus. In seborrhœa sicca the light yellow crusts do not form cups, and have not the peculiar odour of favus, and there is no fungus. Contagious impetigo has many characteristics in common with favus; but the scabs are not cup-shaped, nor do they contain fungus. Pustular syphilide, occurring early, may be diagnosed by the presence of other symptoms—sore-throat, &c.—and the mixed character of the eruption; rupia by the ulceration seen on removal of the crusts and by their conical shape. In ringworm of the scalp the different appearance of the fungus and the short, broken condition of the hairs, form a sufficiently clear distinction. In the later stages, when the hair has been destroyed, favus may be mistaken for alopecia areata and lupus erythematosus; in the former of these, however, the hair falls out, leaving smooth, bald patches, without scar; while the latter is usually seen on the face as well as on the head, and there is moreover on the margin of the scar the characteristic red appearance, and the sebaceous plugs can be extracted from the follicles.

Pathology.—When examined under the microscope the cups are seen to be composed almost entirely of fungus, called after the discoverer, Achorion Schoenleinii. The mycelium or threads are made up of ovoidal segments containing granules; the spores are large as compared with ringworm.

Treatment.—Most authorities in the countries in which favus is common lay great stress on constitutional treatment, particularly change of air to dry localities, good food, and tonics, such as iodide of iron and cod-liver oil. But, however much good may be gained from such means, a cure cannot be effected without local treatment, which must be most thoroughly carried out. The first point is to remove, by oiling, all cups and scabs, and the hairs that are diseased must be carefully epilated. Poultices should never be used, as the heat and moisture encourage the growth of the fungus. After all the crusts on the surface have been removed, the deep-seated fungus must be destroyed in one of two ways—that is to say, either by setting up inflammation by means of irritants, such as strong ointments containing carbolic acid or mercurial preparations, or by blistering; or else by applying certain drugs, not necessarily strong, that have the power of killing the fungus without inflaming or injuring the skin. Such drugs are known as parasiticides. If the former plan be adopted, care must be taken not to produce too great an inflammation, and soothing remedies must be used as soon as the fungus is destroyed. Oleate of mercury 5 or 10 per cent. is a useful remedy. As parasiticides may be mentioned: perchloride of mercury, 2 gr. to f℥j. of equal parts of sp. vini rect. and water; sulphurous acid; hyposulphite of soda, ʒj. to f℥j.; salicylic acid; boracic acid; thymol; menthol; and many others of a similar nature. When a strictly parasiticide action is required, it is important not to use fatty applications, as they tend to block the hair-follicles and so prevent the destroying drug from reaching the fungus. Ether, chloroform, and spirit are all good penetrating vehicles. The nails should be softened with liq. potassæ, scraped, and kept covered with lint soaked in one of the above-mentioned lotions. The head should be washed from time to time with a disinfecting wash, but plain soap and water should only be used with extreme caution. As favus is a very chronic disease, it must be understood that patience is required, as well as drugs, to effect a cure.

Malcolm Morris.

FEMALE CATHETER. — Several varieties of this instrument are usually sold, but the simplest form is the best, as admitting of being most effectually cleansed. This consists of a slightly curved silver tube, six or seven inches in length, and of the diameter of a No. 8 English male catheter, perforated with five or six small openings on either side near its extremity, and fitted with a fine wire stilette mounted on a movable metal plug.

When in constant use after operation, the catheter should always be thoroughly cleansed by a stream of warm water immediately after being passed, and then be placed in a vessel containing 1–20 carbolic solution until it is again required.

Method of Introduction.—This should always be effected by touch alone, without any exposure of the patient. From the right side of the bed the forefinger of the right hand is passed from behind forward between the nymphæ until the projection of the meatus urinarius—continuous with the cord-like urethra—is detected immediately in front of the entrance to the vagina beneath the pubic arch. The point of the catheter, held in the left hand, is then carried along the palmar surface of the right index finger until it enters the orifice. Unless the above plan be followed, the instrument is liable to pass into the vagina, and thus become coated with mucus or other secretions, which, if subsequently conveyed into the bladder, may readily excite catarrh of that organ. It is better, therefore, should this accident occur, to at once wash and re-carbolise the catheter before again attempting its introduction.

For *retention in the bladder*, the best form of instrument is a short, slightly-curved vulcanite tube terminating in a perforated olive-shaped bulb, to prevent its escape after introduction. A suitable length of rubber tubing, attached to its outer extremity, will convey the urine into a vessel beneath the bed containing some disinfectant solution.

W. A. Meredith.

FEMORAL ANEURISM.—A pulsating blood-sac in direct connection with the femoral artery, more common in Scarpa's triangle than in Hunter's canal, probably because the artery in the former place is more exposed to injury, and is less supported by surrounding muscles, than in the latter.

Femoral aneurisms spring either from the common femoral, from the deep femoral, or from the superficial femoral artery. Deep femoral aneurism is very much rarer than the other two. Both it and superficial femoral aneurism present very similar physical signs, and the diagnosis between the two cannot always be made. Aneurism of the profunda presents an apparent want of definition from its greater depth, while aneurism of the superficial femoral occasionally interferes with the pulse in the tibial arteries. Neither of these tests, however, can be regarded as very satisfactory, and it will be best to consider these two forms together, remembering that aneurism of the superficial femoral is so much more common than aneurism of the deep artery, that the probability is all in favour of the superficial artery being the one affected.

A regional classification of femoral aneurisms, different from the above, is made use of by some writers. In this classification, if the swelling occurs in Scarpa's triangle it is called an inguinal aneurism, and the term 'femoral aneurism' is restricted to the affection of that part of the artery which corresponds with Hunter's canal.

Aneurism of the femoral below its bifurcation usually presents the form of an ovoid, pulsating, rapidly-growing swelling, the pulsation of which may be readily controlled by pressure on the artery as it crosses the pelvic brim. While this pressure is kept up, the swelling gradually diminishes in size from partial emptying of the sac, but directly the pressure is taken off the sac fills again, with a strong expansive force. If the sac be of large size, there may be signs of venous pressure in the parts below. Thus there may be more or less œdema of the foot, or a gorged and varicose condition of the superficial veins below the knee. Aneurism of the common femoral presents somewhat similar signs, but it occurs higher up in Scarpa's triangle, and very often runs on into the external iliac artery, the swelling being felt as much above Poupart's ligament as below.

Femoral aneurism may be either sacculated, fusiform, or diffused. The first is the most common; but the long, straight course of the artery sometimes favours the formation of a fusiform aneurism. A diffused aneurism may either result from traumatic causes, or from the rapid spread of the disease and bursting of the sac in either of the other forms.

Treatment.—If the pulsation in either a sacculated or fusiform femoral aneurism can be easily controlled by pressure on the artery as it passes over the pelvic brim, an attempt should be made to cure it by compression. This may be done, if the aneurism is sufficiently low down, by two tourniquets, placed the one on the pelvic brim, the other about two inches below this point, so that the one may be relaxed while the other is tightened. In this way alternate pressure is obtained on different points, and the risk of bruising and injury to the soft parts is very much lessened. Or a combination of instrumental and digital compression may be applied. The lower of the two tourniquets spoken of above may be retained, and in place of the upper, the finger compressing the artery may be substituted. If the aneurismal swelling extend up near to Poupart's ligament, digital compression will, probably, be the only method effectually applied. This will require a staff of three assistants, so that due relief may be given as each one compressing the artery becomes tired. It has been found that ten minutes is about the average time for one person to maintain effectual compression of the femoral artery. The arrangement of the three assistants, therefore, is best made thus: one man compressing the artery; the second sitting with his hand on the aneurismal sac, to give warning directly a pulsation is felt; the third assistant resting. If the patient be very quiet, the action of the second assistant can sometimes be replaced by the use of a long, light lever, such as a bit of whalebone bougie, one end of which is fixed by a joint to some immovable substance placed close to the limb, the bougie itself resting on the aneurismal swelling, and the long arm projecting beyond it. A pulsation is then indicated by the long arm rising in the air.

Whichever method be adopted, considerable patience and endurance will be needed on the part of the patient, if a successful result is to be attained. Digital compression is usually more speedy than instrumental, because generally more perfectly applied, and twenty-four to forty-eight hours should, in most cases, decide the question whether it is possible to cure the patient in this way. It is often necessary to keep the patient very much under the influence of morphia during its application, in order to avoid the distressing and harassing pain which it often entails. Compression is generally a less successful mode of treatment with femoral aneurism than with popliteal, and if the patient prove refractory, or if the aneurism be manifestly increasing in size, it will be best to adopt operative proceedings.

The particular operation selected will depend upon the part of the artery affected. If it be the superficial femoral in Hunter's canal, ligature of the same artery near the apex of Scarpa's triangle will be advisable. If the aneurism affect the deep femoral artery, ligature of the common femoral or of the external iliac must be had recourse to. The same is true if the superficial femoral in Scarpa's triangle is the part affected, and if the common femoral be the seat of disease, ligature of the external iliac becomes compulsory. In those cases where there is a choice between ligature of the external iliac and common femoral, it is, probably, best to choose the former. The unfavourable statistics respecting ligature of the common femoral have been very much modified of late by the successful results of the Dublin surgeons in this operation. Independently, however, of these statistics, it is probable, for many reasons, that the external iliac will be a better and safer artery to tie than the common femoral; not the least of these reasons being the uncertainty which always exists as to where the common femoral divides.

Should a femoral aneurism have become diffused, an attempt may still be made to cure it, by compression or ligature, if it be seen sufficiently early. If the swelling be extensive, it may be necessary to amputate. The only operation which may then possibly save the limb is that in which the sac is boldly laid open, and the artery ligatured above and below.

H. G. Howse.

FEMORAL ARTERY.—The Common Femoral runs from the level of Poupart's ligament, in a line drawn from a spot midway between the anterior superior spinous process of the ilium and the symphysis pubis to the adductor tubercle; its average length is two inches, but it varies from half-an-inch to four inches.

The coverings are:—(1) Skin, thin and freely movable. (2) Superficial fascia, here consisting of a superficial and deep layer; the latter is called the cribriform. (3) Between the layers are the femoral glands, the crural branch of the genito-crural, and cutaneous branches of the common femoral artery with the accompanying veins. (4) Fascia lata, called at this part the iliac portion, being on the outer side of the saphenous opening. (5) The femoral sheath, embracing the femoral vessels. This sheath is formed by the transversalis and iliac fasciæ of the abdomen escaping from beneath Poupart's ligament—the former in front of, and the latter behind, the femoral vessels. There are in it three compartments, separated by two septa; the inner, for a gland, is called the crural canal; the middle is for the vein; and the outer for the artery. The sheath is but loosely applied to the artery, it being common to both artery and vein; but within the common there is the immediate sheath, characterised by its vasa vasorum.

The relations are:—In front, the coverings just mentioned. Behind, the psoas, resting on the horizontal ramus of the pubes, the anterior part of the hip-joint, and the head of the femur; when pressure is applied, the vessel slips from off the psoas, to rest internally on the origin of the pectineus. Internally, the vein. Externally, one-third of an inch from the sheath, are the branches of the anterior crural nerve lying in a groove between the iliacus and psoas.

Ligation is required for wounds, for aneurism, and varicose aneurism. Place the patient in the recumbent position, with the knee semi-flexed, the thigh slightly flexed on the abdomen, and the limb abducted; make an incision 2½ inches long over the artery in the line of the vessel, cutting downwards on the right side and upwards on the left, the incision beginning or ending just below Poupart's ligament. The structures cut through are the coverings (*see* above); the recognisable tissues are the skin, fascia with fat, fascia lata, common and immediate sheaths. When the immediate sheath is opened, the needle is passed from within outwards—i.e. from between the vein and artery. Another method of ligation is to make an incision parallel to Poupart's ligament and half an inch below it. There is then no difficulty in finding the artery and in opening the sheath directly over it.

The Superficial Femoral.—Course: From half an inch to four inches below Poupart's ligament in the guiding line given for the common, to the opening in the adductor magnus, which is, in the adult male limb, four inches, in a vertical line, above the adductor tubercle.

The coverings:—(1) The skin, movable and thin. (2) The superficial fascia, containing fat in its superficial layer; but the deep layer at the upper part is distinct, and called cribriform. The middle cutaneous nerve runs superficially to the artery. The internal saphenous vein runs upwards just internally to the line of the femoral artery. (3) The fascia lata looks thick and white above, but over the sartorius it is thinner, and allows the colour of the muscle to show through it. (4) Beneath the fascia lata, at the upper part—i.e. in Scarpa's triangle—there is a quantity of fatty tissue; beneath the fascia, below Scarpa's triangle, the sartorius muscle covers it. (5) The sartorius muscle, four inches below Poupart's ligament, touches the adductor longus, and then pursues a course downwards and inwards over the superficial femoral artery, and onwards across the knee to the tibia. The part above where it touches the adductor is Scarpa's triangle; the part below, Hunter's canal. As the artery lies in the triangle, the muscle is to the outer side; as the vessel lies in Hunter's canal, it is best exposed at the upper part by pulling the sartorius outwards, but at the lower part inwards. (6) Beneath the sartorius, and over Hunter's canal, is a special fascia—thick below, thin above—which passes from the vastus internus to the adductor longus muscle, the two boundary muscles of the canal.

Relations of the artery. A. *In Scarpa's triangle.*—This triangle is formed by the adductor longus internally; the sartorius externally; the base by Poupart's ligament; the apex four inches below the groin, where the sartorius crosses the adductor. In front, the structures given as coverings are the skin, superficial and deep fascia, and some fat. Behind, the superficial and deep femoral veins unite to form the common; a small quantity of fatty tissue separates the femoral vessels here in addition to the veins. Internally, the vein can be seen only at the upper part. Externally, the internal saphenous nerve and the nerve to the vastus internus gradually approach the artery from the anterior crural.

Ligation.—Select a point five inches below Poupart's ligament; keep this as the focal point in the operation. Place the limb as for the common; cut in the guiding line of the artery from two inches above to two inches below the focal point. Cut through skin, fat, cutaneous branches of vessel and nerves, cribriform fascia, fascia lata. Recognise the inner edge of the sartorius, clear away a small quantity of fatty areolar tissue, open the sheath, and pass the needle from within outwards to avoid the vein, especially if it is passed high on the artery.

B. *In Hunter's Canal.*—Hunter's canal extends from where the sartorius covers the superficial femoral above, to the opening in the adductor magnus. It is bounded externally by the vastus internus, internally by the adductor longus, and the roof of the canal is formed by the special aponeurosis above-mentioned. In front the coverings of the artery are skin, superficial fascia, fascia lata, sartorius muscle, and the special aponeurosis; the internal saphenous nerve lies on the artery at the lower part only. Behind, the superficial femoral vein and adductor longus muscle. Internally, the adductor longus and a bit of the magnus below. Externally, the vastus internus with the internal saphenous nerve, and the nerve to the vastus internus.

Ligation of the superficial femoral artery in the middle of the thigh—that is, at the lower third of the vessel. Place the limb as for the common femoral. The surgeon stands on the outer side of whichever limb is to be operated on, cutting upwards upon the left side, downwards upon the right. The incision is to be taken one finger's breadth internal to the guiding line. With the limb held in the position as for ligature of the common femoral, make an incision four inches long, with its central point midway between the groin and the knee. Cut through skin, superficial fascia, and branches of the middle cutaneous nerve. Recognise the sartorius, and divide the fascia lata along its outer border; draw the muscle inwards and backwards by a spatula; open the special aponeurosis forming the roof of the canal on a director. The vessel is now seen with the internal saphenous nerve lying on it; pull the nerve outwards; open the sheath, and pass the needle from without inwards. James Cantlie.

FEMORAL ARTERY, Wound of the.—Incised Wound.—It rarely occurs that opportunity is afforded for surgical interference involving the main vessels, for so severe an injury usually proves rapidly fatal before assistance can be obtained. If the bleeding has been temporarily arrested by firm bandaging by the bystanders, and an immediately fatal issue thus prevented, the surgeon, before attempting to remove the bandages, should have a tourniquet, or the fingers of an assistant, placed in position over the vessel in the groin, so as instantly to exert compression should bleeding occur on removal of the bandages. It is also of great value to have a second assistant to exert compression, if necessary, below the wound.

The clot being rapidly sponged out, it may happen that the stream of blood may at once point to the wounded vessel, which can be readily secured by ligature. If, owing to the retraction of a vessel, instead of a distinctly bleeding point, blood appears to well up from the tissues, the finger should be placed over the spot, and the tissues cautiously dissected up in the longitudinal direction, and if more space is required to accomplish this, the superficial wound must be enlarged. The vessels having been securely tied with catgut, and the wound cleansed, the soft parts may be brought together. If it has been the femoral artery that is wounded, it is very probable that the vein has been at the same time damaged. In such a wound the probability of gangrene must be remembered, so that, while searching for the wounded vessel, the limb should not be unnecessarily exposed, for all the warmth possible should be retained as helping the anastomosing circulation.

When the operation is completed, the entire limb should be wrapped in cotton wool kept in position by a loose flannel bandage. The limb being slightly flexed at the knee and thigh, should be a little raised on a soft pillow.

Punctured Wound.—In a punctured wound it is impossible to say with absolute certainty that it is actually the femoral itself furnishing the blood, but if the wound be in the line of this vessel, and the bleeding of great volume, it is a fair inference to draw that the blood flows from the main artery. If the wound be in the upper half of the thigh—that is to say, in a position where the femoral artery is comparatively superficial—and situated over the course of the vessel, the surgeon may enlarge the opening with a good prospect of finding the wounded vessel without an extensive or prolonged operation. If the wound be in the lower half of the thigh, owing to the greater depth of the artery, and the possibility of its being the popliteal that is wounded, the search is rendered a far more severe and hazardous operation, and it should not be undertaken until a thorough trial of pressure has proved ineffectual. The method of applying pressure is explained under the heading of secondary hæmorrhage from this artery.

Wound of the Femoral or Popliteal, complicated with Fracture.—This is an accident which may occasionally occur in fracture of the lower end of the femur, and the popliteal has been wounded immediately behind the adductor magnus by a spiculum of bone after Macewen's operation for genu valgum. When hæmorrhage occurs after a compound fracture or osteotomy, it is of course impossible to know with certainty whether it is the main vessel or only a branch that is wounded. Pressure should be tried in the first instance, and if this fail the wound may be laid open, and the bleeding point searched for. Should this prove to be but a branch of the main vessel, it should be secured; but supposing, after laying open the wound, that it be found to be the main artery itself (the femoral or the popliteal) which is wounded, the safest course is to amputate the limb. It cannot be denied that it may occasionally happen that, by tying the wounded artery, both the life and limb of the sufferer may be saved; but looking at the terrible complication of such an accident, involving as it does an extensive incised wound, a fracture of the bone, and ligature of the main vessel, the chance of saving the limb is too remote to be weighed against the risk to life incurred, and amputation should be performed.

Secondary Hæmorrhage from the Femoral.—This must be considered, first, with reference to secondary hæmorrhage from the vessel after its ligature in continuity; secondly, when occurring from a thigh-stump.

Secondary Hæmorrhage from the Artery tied in continuity.—Four plans have been advocated for treating this serious accident, viz. (1) ligature of the external iliac; (2) pressure and bandaging; (3) an attempt to apply a ligature within the wound; (4) amputation.

Ligature of the external iliac has been mentioned merely for the purpose of condemning it, since in the vast majority of cases in which this procedure has been adopted, it has either failed to arrest the hæmorrhage, or, if it has done so, it has been only at the expense of gangrene of the limb. The ligature of the iliac, therefore, is a dangerous and perfectly useless operation, and should be abolished as a method of treatment in hæmorrhage from the femoral.

Treatment by Pressure.—This undoubtedly is the method by which secondary hæmorrhage should be treated in the first instance, and, if properly carried out, will in many instances effectually and permanently control the bleeding. Few studies in surgery are more instructive and interesting than that of the literature of secondary hæmorrhage from the femoral artery; for, not only is it shown that many cases have been successfully treated by pressure from the first, but that both life and limb have been saved by this means after the surgeon has failed to find the artery in the wound, or where the iliac has been tied in vain.

Method of applying Pressure.—Great care and attention to detail are necessary for its successful application, for, on the one hand, if an undue amount of force be used, gangrene results; on the other, if it be but timidly applied the treatment will prove ineffectual. It should further be remembered how frequently, in secondary hæmorrhage from an artery tied in its continuity, it is the lower end of the vessel that furnishes the blood, so that it becomes a matter of great importance to exert well-directed pressure not only above but below the wound. The main vessel being effectually compressed in the groin, the limb, gently raised, is carefully bandaged from the foot upwards to within a short distance of the wound, which is not covered. The tips of the toes should be left exposed, in order to allow the surgeon to judge of the condition of the circulation. The bandage is then continued as a spica above the wound and over the groin. Rollers the thickness of the index finger, prepared as previously described, are then placed along the course of the main vessel, the one above, the other below the wound. These rollers are placed outside the flannel bandage enveloping the limb, and are kept in position each by a few turns of a separate bandage. A conical pad of eighty pieces of lint, the smallest the size of a shilling, the largest two inches in diameter, is laid directly over the orifice from which the blood has been issuing. This pad being liable to slip, must be kept in position by a couple of cross-pieces of narrow strapping, after which compression can be exerted on it by a few turns from a roller. *See* ARTERIES, Wounds of.

On the opposite or outer side of the thigh may be placed a well-padded broad splint, over which the three bandages compressing the two rollers and the conical pad are carried. The value of the splint consists in firm pressure and counter-pressure being obtained without the thigh being circularly compressed. The compressing pads, being independent of each other, allow of the pressure being diminished or increased as any one of them may require. The whole limb should be slightly raised on a pillow, and partially bent at the knee and thigh.

Search for the Bleeding Vessel in situ *and Amputation.*—If hæmorrhage recur, and cannot be controlled by tightening one or other of the pads, the whole apparatus should be removed, and once more carefully applied. Should this fail, or the limb be in such a condition as to forbid the further trial of pressure, an attempt may be made to tie the artery in the wound, and in a good light with a little dissection upwards and downwards this may sometimes be successfully accomplished; but it has occurred to surgeons of experience, that, owing to the disorganised state of the part, they have failed to pick up the vessel. If this be the case, desperate as the measure may seem, there remains no alternative other than that of amputating the limb through or just above the seat of ligature.

The greatest care should be observed in such an amputation that as little blood as possible be lost, and a Davy's lever, or other effectual means of preventing hæmorrhage during the operation, must be resorted to.

Secondary Hæmorrhage from the Femoral Artery in a Stump.—The following are the three methods by which the bleeding may be treated:—(1) pressure; (2) reopening the flaps; (3) ligature of the main vessel at a higher point.

Pressure.—A tourniquet being placed on the artery in the groin, the stump is raised and, as far as practicable, the clot, if it has distended the flaps, syringed away with cold, carbolised water. The stump is then very firmly and evenly bandaged from its extremity to the groin. Two pieces of pencil, each about three inches in length, and thickly wrapped round with lint, may be laid along the course of the femoral artery. Compression is exercised upon these by two separate bandages, passing round the limb and over an outside splint on the opposite side to avoid complete circular pressure. The advantage of having the roller compress over the main artery in two portions, is that more equable pressure is maintained by tightening or relaxing one or the other as occasion may demand. The bandage used for exerting pressure on these compresses should be of domette, which has much more elasticity than cotton. Whilst the stump is being bandaged and compression applied, firm digital or instrumental pressure must be exercised in the groin. If pressure should fail to stop the bleeding, the surgeon may fall back upon one of the remaining alternatives, that is, either opening the flaps or ligaturing the main vessel higher up. Which of these proceedings is best to adopt depends upon the amount of union between the flaps.

If the bleeding should occur early in the case, before firm union is established, say within the first fifteen or twenty days, the flaps may be separated by the finger, and the vessel sought for. It is not, however, always easily found, owing to its retraction, and its being covered by granulations. With a little perseverance, however, and by using a director rather than a knife, it may be discovered and isolated from the surrounding tissue. It is well to remember how very soft the end of the vessel becomes in these cases of secondary hæmorrhage, so that the ligature of thick soft silk must be tied with much gentleness. It has occasionally happened when the surgeon has been unable to isolate the artery, that it has answered to pass a large curved needle threaded with the ligature deeply beneath the bleeding part, thus including the artery with a considerable portion of the neighbouring structures.

If the hæmorrhage has come on late in the case, the flaps being united, and the blood issuing from a sinus at the angle of the flaps, it is a less formidable procedure than breaking open so large a wound, to put a thread round the main vessel by cutting down upon it as near above the flaps as it can be conveniently found. Thus, if the amputation be through the knee-joint, the artery may be secured in Hunter's canal. If the amputation be through the middle of the thigh, the vessel should be tied in Scarpa's triangle. HARRISON CRIPPS.

FEMORAL HERNIA.—In this form of rupture the gut leaves the abdomen through the femoral ring, and descends along the crural canal. This canal is funnel-shaped, is about half an inch in length, and ends opposite the saphenous opening. Femoral herniæ are always acquired, and possess a sac. The hernia in its descent first of all takes a vertical course. At the lower end of the crural canal it bends forwards, and then tends to mount upwards over Poupart's ligament. In the upward movement it inclines also outwards in the direction of the anterior superior spine. The neck of the hernia will be at the femoral ring. The rupture, as it lies within the canal, must always be small. As soon, however, as it passes the saphenous opening and reaches the loose subcutaneous tissue, it enlarges, and may attain considerable dimensions in this latter position. The coverings of the rupture from without inwards are the skin, superficial fascia, cribriform fascia, the crural sheath, septum crurale, subserous tissue, and peritoneum. The stricture is usually at the neck, and is mainly caused by the sharp edge of Gimbernat's ligament. The femoral vein lies just to its outer side. The spermatic cord lies above the anterior border of the ring, and the epigastric artery skirts its upper and outer part. The little pubic branch of this artery passes round the ring, to ramify over Gimbernat's ligament. In 1 case in 3½ the obturator artery arises from the epigastric. Out of 101 cases where the vessel so arose, it reached its destination in 54 instances by passing along the outer side of the crural ring, a position quite free from danger in herniotomy. In 37 cases it passed backwards across the ring, and in 10 instances around its inner border. When in the last-named situation it could hardly avoid being wounded in herniotomy. A pubic vein—passing between the obturator and external iliac vein—skirts the ring, and may have the same relations to it as the artery just alluded to.

It is estimated that in 100 cases of hernia 84 will be inguinal, 10 femoral, and 5 umbilical. Femoral hernia is more common in females than in males. In males ruptures occur in the proportion of 1 femoral to 32 inguinal; but in females these two forms of hernia occur with almost equal frequency. Inguinal hernia is, excluding the umbilical, practically the only form of rupture that occurs in the female before the adult age.

Femoral herniæ are rare before the age of twenty, and very rare indeed before puberty. They seldom attain great size. When large their coverings are often very thin, and the sac of lobulated and irregular outline.

Femoral ruptures are more often strangulated than inguinal, are more often strangulated on their first descent, and are, in any case, much more difficult to reduce. Irreducible femoral enterocele is rare, but irreducible femoral epiplocele is common. Femoral ruptures are frequently inflamed, but very rarely obstructed. When strangulation has occurred, it is found that gangrene of the gut and artificial anus follow more commonly in femoral than they do in inguinal herniæ.

In applying the taxis the thigh should be flexed, adducted, and rotated inwards. If the tumour has mounted up over Poupart's ligament the pressure must be applied first in a downward direction, then backwards and upwards. In herniæ of smaller size, which have not projected far beyond the saphenous opening, the pressure is applied in a direction backwards and upwards.

In herniotomy an incision from 1½ to 2 inches in length is made along the inner side of the tumour. This incision should be parallel to the long axis of the tumour, provided that this does not involve too great a deviation from the vertical line, and should be so planned that the centre of the incision corresponds to the top of the saphenous opening. The stricture is divided by cutting inwards.

Femoral herniæ have been mistaken for psoas abscess, enlarged glands, varicose veins, and cysts. For the diagnosis *see* Groin, Affections of the. When a femoral rupture has mounted up over Poupart's ligament, it may present some of the appearances of an inguinal hernia. If, however, the finger be placed upon the spine of the pubes, the inguinal hernia will be always to the inner side of it, the femoral to the outer. The bulk of a femoral hernia is also below the line of Poupart's ligament, and the tumour can without difficulty be traced down to the saphenous opening.

Frederick Treves.

FEMUR, Fractures of the. — The numerous fractures to which the femur is liable are divided into those of (1) the upper end, (2) the shaft, (3) the lower end. Those of the upper end include fractures of the neck, fractures through the trochanter and base of the neck, and fracture detaching the great trochanter. To these must be added, in young subjects, separation of the epiphysis of the head, and that of the great trochanter.

Fracture of the neck may occur in any situation—either transversely, just below the head; in the middle; or at the base, at its junction with the shaft. The first-named injury, though it has been met with under the age of fifty, or even under twenty, after heavy falls on the trochanter, is almost confined to persons of sixty-five and upwards, and is more frequent in women than in men. In the old it occurs as the result either of a fall on the hip, or of some slight force indirectly applied, by a trip of the toe in the carpet or even a turn in bed, during which the femur is suddenly twisted on its long axis; in a few instances it has been produced by muscular action. The frequency of the accident in advanced life is due in part to atrophy of the bone, the cortical layer of which is thinned, while the plates of the cancellous tissue are absorbed; and in part to the fact that the neck often joins the shaft at a right angle instead of at an angle of 125°, as is the case earlier in life; so that not only is the trochanter more prominent and therefore more likely to be struck in falls on the hip, but the leverage with which any force acts through the shaft on the neck is much increased. Should the fracture be the result of a fall on the trochanter, impaction may occur, the lower fragment being driven into the cancellous tissue of the head; but, owing to the trivial character of the force by which the injury is generally produced, impaction is seldom present. In rare instances the head is said to be driven downwards and backwards, but as a rule it remains in the acetabulum, where, however, it is liable to more or less rotation, so that its broken surface is turned away from the lower fragment. Fracture through the middle portion of the neck may be either transverse, or oblique from above downwards and inwards, extending from the outer margin of the head to the neighbourhood of the lesser trochanter.

Fracture through the base of the neck, in a line with the anterior trochanteric ridge, though it is, like fracture close to the head, most common in elderly persons, may be met with at any age, as the result of falls on the trochanter. By the continuance of the force under which the bone gives way, the upper fragment is usually driven into the cancellous tissue of the trochanter and shaft. Should the force be only moderate, the fragments remain securely impacted, and displacement is slight; but when it is more considerable the trochanter is split in a longitudinal direction, and, perhaps, also detached from the shaft, so that the fragments are no longer mutually grasped. When this is the case the surrounding muscles draw up the limb and produce considerable shortening. This fracture was termed extra-capsular by Sir A. Cooper, in contrast to fracture higher in the neck, which he termed intra-capsular. Later writers, however, have justly pointed out that since the capsule entirely invests the neck in front, any fracture that is extra-capsular in this situation must involve, not the neck, but the shaft. Indeed, the division of fractures of the neck into the intra- and the extra-capsular groups has been by many authorities discarded, on the ground that, though there are highly important differences between fractures of the upper part and fractures of the base of the neck in respect to the prospect of union and the future condition of the limb, these are dependent, not so much on the relation of the fracture to the capsule, as on the different ages at which these injuries are chiefly met with, and the fact that in the former impaction is rare, while in the latter it is of almost constant occurrence.

Symptoms.—In a typical instance, after a fall on the hip or knee, a false step, or even a turn in bed, or some such trivial source of injury, the patient complains of sharp pain on any attempt at movement, and of a powerless condition of the limb. On examination the limb is seen to be shortened to the extent of half an inch to an inch and a half, or even more, and everted; the patient is unable to lift the heel from the bed; the trochanter is displaced upwards, and also inwards towards the middle line, so as to be less prominent than natural. There is swelling in front of the joint, due to projection of the fragments against the front of the capsule, or sometimes to extravasated blood: pressure over either the front or back of the joint is painful. Crepitus may perhaps be felt when the limb, after it has been drawn down to its proper length, is gently rotated inwards and outwards; and during these movements the trochanter is found to move through an abnormally small arc. It must be pointed out, however, that cases are often met with in which many of these symptoms are modified, or even entirely absent. Thus, owing to the presence of impaction, or more rarely because the periosteum is untorn, or more rarely still because the fracture is incomplete, the patient may be able to move the limb freely, or even walk upon it. Shortening of the limb, and displacement of the trochanter, though they are usually distinct, may be so slight, or so masked, the one by the difficulty of placing the two limbs in the same position while the measurements are taken, the other by the stoutness of the patient, that they cannot be clearly made out; in some cases eversion is very slight, and is detected only by the fact that during manipulation the surgeon experiences a difficulty in turning the foot inwards. Sometimes the foot is in its natural position, while very rarely it is markedly inverted. Crepitus is absent when, as is so commonly the case, the fracture is impacted, and also when the fragments are displaced in relation to each other; and although it may be sometimes produced by drawing the limb down and then rotating it, manipulation for the purpose of eliciting this symptom must always be employed with great caution, in view of the danger that so favourable a condition as impaction may be sacrificed, and the fracture converted into one in which the fragments may become widely displaced.

Shortening, in a previously healthy limb, is important evidence when fracture is suspected; but its absence must not always, as already indicated, be taken as any proof that fracture has not occurred. In taking measurements great care must be used. The pelvis must be placed so that the anterior superior iliac spines are on the same horizontal level, and the two limbs must be parallel to each other and in a straight line with the trunk. Above, the superior iliac spines are the most salient points, and below, either the upper edges of the patellæ or the tips of the external malleoli; but it is a useful precaution to measure to both these lower points, and to see whether the results agree. Very valuable information is afforded by the position of the great trochanter. If fracture is present, the trochanter is higher and at the same time less prominent—that is, nearer to the middle line than that of the opposite side.

The position of the trochanter may be ascertained either by Nélaton's or Bryant's line. Nélaton's line is drawn from the anterior superior iliac spine to the most prominent part of the tuberosity of the ischium. In the normal state, in no position of the limb does the trochanter extend above this line, while in fracture it lies above it by as much as the limb is shortened. It must, however, be borne in mind that when the neck of the femur forms a right angle with the shaft, as it may in persons in whom the bone has yielded during the atrophy of advancing life, and also in many of those who were rickety during infancy, the trochanter is placed above Nélaton's line. Moreover, the exact point of the tuber ischii to which the line should be drawn is difficult to select when the patient is stout, or when swelling is present. This test should therefore be checked by other measurements, and the suspected should always be compared with the sound side. Bryant draws a horizontal line backwards from the anterior iliac spines (that is, a line which, if continued, would form a circle round the pelvis at this level), and takes the vertical distance between it and the top of the trochanter, comparing the length of this vertical line with a similar measurement on the opposite side.

Eversion, which is generally present, and which in many instances forms so marked a symptom, is due chiefly to the weight of the limb, which as its line of gravity passes through its outer part, has a natural tendency, as is seen in sleep, to turn outwards; but it depends in part on the action of the external rotator muscles, and in part, also, on the circumstance that the neck of the bone is thinner and more brittle in its posterior aspect than it is in front, and is therefore prone to be more extensively broken down in the former than in the latter situation.

Diagnosis.—The accidents with which fractures of the neck of the femur are most likely to be confounded are—fracture of the upper border of the acetabulum and displacement of the femur upwards; fracture of the bottom of the acetabulum, the head of the bone being driven through its floor; dislocation of the femur upwards and backwards, or on the pubes; severe bruising about the hip. In elderly persons, however, in whom fractures of the upper end of the femur are so common, fractures of the acetabulum, whether involving its rim or its floor, are almost unknown; and though in early or adult life they are occasionally met with as the result of great violence, they are still of very rare occurrence. In fracture of the edge of the acetabulum, if a large piece is detached, the limb will be shortened to the extent of an inch or much more, but can be easily drawn down when the patient is under an anæsthetic, and when traction ceases, shortening recurs; while when the femur has been drawn down it is found to present its natural outline of neck and trochanter, and to rotate naturally in the acetabulum. In fracture of the floor the trochanter is carried towards the middle line, so that its prominence is altogether lost, the bone is fixed, and any attempt at movement causes great pain. Possibly this fracture might be detected by the finger introduced into the rectum. In dislocation on the pubes, a very rare accident, the head of the bone can be felt on the pubic ramus, the normal outline of the upper end of the bone can be traced, and, moreover, the limb is generally, in this dislocation, markedly abducted.

When severe bruising has occurred, it may be difficult to exclude the existence of fracture, and a guarded opinion must be given till further examination shall have cleared up the doubt. In the article on INJURIES TO THE HIP those cases are mentioned in which after severe contusion, without fracture, shortening, eversion, and other signs of old fracture of the neck, come on as the result of chronic inflammation and absorption. These examples have sometimes led to unjust charges of malpractice. Fracture through the great trochanter and base of the neck, so that the upper fragment is composed of the head, neck, and a portion of the trochanter, while the remainder of the trochanter forms part of the lower fragment, is an accident of which a few instances are recorded—amongst them one by Sir A. Cooper, and one very clearly described by Stanley (*Med.-Chir. Trans.*, vol. xiii.), and verified by post-mortem examination. The main interest in respect to this injury lies in the fact that it is very likely to be mistaken for dislocation. In Stanley's case the upper fragment of the trochanter had been drawn upwards and backwards towards the sciatic notch, where it was supposed to be the head of the femur. Diagnosis turns on the fixed position of the trochanter when the shaft of the femur is rotated, and the presence of crepitus. Shortening will be slight if the separation of the fragments is incomplete. When, however, the fragments are widely separated, considerable shortening is produced by the muscles acting on the femur below the fracture, and eversion is very marked.

Prognosis in these fractures must often be very grave, and should always be guarded, for while many cases recover very favourably, in many others, occurring in old persons, in spite of all the care that can be used, the injury is followed by exhaustion, congestion of the lungs, large pressure-sores, or by cystitis following enlarged prostate, and unavoidably aggravated by the use of catheters, and the patient sinks; while, even if a fatal result is averted, the limb often remains crippled, and a source of much suffering and distress.

Treatment.—This must vary somewhat with the circumstances of each case; but as it is now a well-established fact that fractures within the capsule may be repaired by bone, or by close and firm ligamentous substance; and as, in fractures of the base of the neck, bony union is of common occurrence, all cases of fracture of the upper end of the femur should, with the exceptions mentioned below, be treated with a view to obtain this result. In order to keep the fragments in apposition and at rest, the appliance most commonly in use, and on the whole the best, is the ordinary long splint carefully padded, interrupted opposite the fracture, and reaching from the armpit to the foot. Some surgeons employ Thomas's splint. With this the patient can be more easily moved and turned over, so far as this is necessary for cleanliness; but unless the bar of which it is constructed is flat, wide, well-padded, and accurately moulded to the shape of the trunk and limb, and unless the patient is placed on a soft mattress, pressure-sores are very apt to form. The double inclined plane was at one time much in favour. It is now, however, but seldom used, for it exercises no reliable influence on the length of the limb, and its tends to concentrate pressure on the sacrum. Moreover, the position of flexion which it entails is, in the long run, more irksome than that of extension in the horizontal posture.

In cases where there is impaction, the only indication is to keep the fragments at rest and prevent their separation. No extension, therefore, either at the time the fracture is put up, or subsequently, should be employed; but where impaction is absent, extension must be used to bring the fragments into apposition, and be continued to maintain them so. The weight and pulley answer well for this purpose, and enable us to discard so useless and objectionable a contrivance as the perineal band. The weight should be applied by means of the strapping stirrup used in hip-disease, and it is easily combined with either the long splint or with Thomas's splint. Counter-extension may be obtained by raising the foot of the bed on bricks or wood blocks. Treatment must be continued for from six to eight weeks. In impacted fracture the splints may generally be removed at the end of six weeks, the limb being kept for another fortnight at rest between sandbags, and steadied by a weight of five or six pounds.

The exceptional cases referred to above are those occurring in very old and feeble persons, in whom confinement in one position would exhaust their strength, and lead to pressure-sores, or passive congestion of the lungs, or trouble in the urinary bladder. In these instances the limb should be placed in an easy position upon a pillow, and be steadied between sandbags, and by a weight of three to six pounds attached to the foot. As soon as bruising has subsided the patient should be raised in bed with pillows for some hours a day, so as to profit by a change of posture, and, later on, may be upon crutches, with the limb supported by a loop passing round the neck and under the sole. It is often difficult in certain cases to determine whether in non-impacted intra-capsular fracture an attempt should be made by the use of rigid apparatus to obtain bony union, for in many instances this will necessarily fail, either from the feeble nutrition of the upper fragment, or because the fragments cannot be maintained in apposition; and there may be a doubt whether the health will not give way. The decision must turn on the patient's age and general strength, and on the presence of any other injuries that may have been sustained, and which would render a constrained position more than usually difficult to bear.

Shaft.—Fractures of the shaft of the femur are much more common in the middle than at either end, and in the lower than the upper third, the proportion, stated approximately, being six in the middle, three in the lower, and two in the upper third. Fracture occurs at all ages and in both sexes, but it is most frequent in adult males, who are more exposed to the injuries by which it is produced. It is caused by violence, either direct, or indirect as in falls on the feet; or by muscular action, of which some remarkable instances have been recorded. In infants the accident has sometimes been produced during birth, and it is often met with in children under three or four. At this age it is apt to be overlooked, since it is often of the green-stick variety, transverse in direction, and attended with little or no displacement of the fragments. The writer has seen three instances in which the bone was broken, under the influence of very slight force, in attempts to straighten the limb in cases of old hip-disease. Spontaneous fracture is not rarely met with as the result of necrosis, or of new-growths which have destroyed part of the shaft.

In direction the line of fracture presents considerable variety. It is, however, generally oblique, and often runs from above downwards and forwards. In some instances the bone is split for a considerable distance in a longitudinal direction. Some cases of spiral or screw-like fracture, chiefly in the upper or the lower third, have been recorded. Occasionally there is double fracture, and as many as three fractures have been met with in different parts of the shaft. Sometimes the fragments are driven the one into the other—usually the lower enters the upper—so as to produce either impaction, or splitting of the base. Displacement is very usually present. In fractures of the superior third the upper fragment tends to be carried forwards and outwards, in part by the action of the surrounding muscles, especially of the psoas and iliacus, and in part by the lower fragment, which is drawn upwards behind it and to its inner side, so as to impart a lifting movement to it. Often, however, the upper fragment projects directly forwards, and it may even be carried inwards or backwards. The lower fragment may not only overlap, or form an angle with, the upper, but be rotated on its own long axis, either outwards, or, more rarely, inwards, so as to produce inversion of the foot.

Symptoms.—These are shortening and deformity of the thigh, which is generally curved forwards and outwards, mobility at the seat of fracture, crepitus on rotation, often to be obtained only after extension, loss of power in the limb, pain on movement. The nature of the accident is usually at once apparent; but in young children, in whom there may be very little displacement, and in adults, when the fracture is transverse, the deformity slight, and the thigh very large, muscular, and difficult to manipulate, or when the injury has led to considerable swelling, fracture may easily be overlooked.

Prognosis.—In the old and feeble, if the accident has been attended with much violence, and in cases in which the fracture is compound, and there is great injury of the soft parts or of the large blood-vessels, prognosis must be grave; but in simple fractures, carefully treated, a good result may almost always be obtained. The question of shortening has been much discussed, some surgeons holding that some degree is inevitable, others maintaining that it may be entirely avoided. The facts, however, briefly stated, are, that in many instances in which much displacement has once occurred, shortening cannot be altogether prevented; and in actual practice the amount varies, in carefully-treated cases, from half an inch to two inches and a half. When, however, the fracture is transverse, or nearly so, and there is little displacement, repair without shortening may be secured. In children, as the fracture is usually transverse, the periosteum incompletely torn, displacement slight, and muscular contraction feeble, no shortening will generally remain. The subsequent length of the limb, however, will always depend largely on the treatment that is adopted, and on the care and watchfulness with which it is carried out.

Treatment. — This subject has been much discussed from very early times, and much difference of opinion still exists respecting it; but in the present article all historical discussion must be omitted, and reference be made only to the chief methods that are now in common use.

The objects to be aimed at are: (1) adjustment and fixation of the fragments; (2) extension to maintain length; (3) support and gentle compression of the limb. The appliance most in favour in the London hospitals is a Liston's or Desault's long splint, reaching from the axilla to the foot, and combined with extension maintained either by the perineal band, by the weight and pulley, or by an india-rubber accumulator. When the perineal band is used, the splint, which should be very carefully padded, is bandaged to the outer side of the limb from the foot to the knee, the roller being passed several times round the foot and lower end of the splint, so that the two are securely connected. The perineal band is now placed in position, extension is made upon the splint and foot together, and, as soon as the limb has been brought down to its full length, the perineal band is drawn tight and securely tied; a bandage is then carried round the thigh and corresponding part of the splint, and a wide band is applied to keep the upper part of the splint in contact with the chest. Many surgeons apply a short back splint, padded, with its convex surface directed forward to the back of the thigh, so as to maintain the normal curvature of the femur forwards. Others place short splints also on the front and inner aspect of the thigh. The perineal band is, however, not in general favour; it is uncleanly, especially in female patients, and it is apt to be either so tight as to excoriate the groin, or so loose as to be useless. These objections are by no means entirely removed even when the band is made of stout india-rubber tubing. To supersede it, some have advised an axillary crutch fixed to the upper end of the long splint; but neither does this answer.

Efficient extension may be obtained by the use of the weight and pulley. A piece of strong plaster, four or five inches wide, and long enough to extend from a little above the knee to eight inches below the foot, and to return to the opposite point of the limb, is applied as a stirrup, and is secured to the limb by wide transverse pieces of strapping and a bandage; a thin piece of wood, of the same width as the strapping and about four inches long, is placed transversely in the base of the loop below the foot, so as to defend the malleoli from pressure; and through a hole in the centre of this, and a corresponding hole in the stirrup, a strong cord is passed and knotted on the proximal side; this cord runs over a pulley fixed to the bottom of the bed, and supports the weight. Care must be taken that the lower end of the splint is not entangled in the sheets, so that the action of the weight is neutralised, and a weight of from seven to twelve pounds or more will be required.

De Morgan's and Bryant's splints have each met with considerable approval. So also has Thomas's splint. Indeed the results obtained depend less on the particular splint that is used than on the care with which the treatment is carried out. In Dr. Gurdon Buck's method the thigh is surrounded by four short splints, fastened with webbing and buckles; extension is secured by the weight and pulley, and counter-extension by the perineal band fixed to the head-end of the bed. As in fracture of the neck of the femur, so in fractures of the shaft of the bone, treatment on the principle of flexing the limb on the trunk by means of the double inclined plane has been generally discarded, the extended straight position being, when long-continued, less irksome than that of flexion. The inclined plane, however, is useful in cases in which either the hip or the knee-joint is ankylosed in a fixed position; and in such instances adequate extension may be secured by using the weight and pulley, the stirrup being fixed to the thigh.

Another plan is to enclose the limb in some immovable apparatus, such as a case of starch, plaster of Paris, gum and chalk, &c. The former material has been strongly advocated by Mr. Erichsen and Mr. Gamgee. The method, however, is open to the objections:—(1) that to enclose a limb soon after a severe injury in a rigid case, which does not accommodate itself to the swelling that may follow, involves serious danger to the circulation; (2) that, once applied, the bandage allows of no examination of the fracture in order to ascertain whether the fragments are remaining in place; (3) that the bandage soon becomes loose, from shrinking of the soft parts. These dangers are not imaginary. Instances have occurred in which the limb has become gangrenous, and others in which when the bandage was removed, great deformity has been found to have occurred. This plan cannot therefore be recommended for fractures of the thigh, although plaster splints are very useful in fractures elsewhere.

Union is generally complete in about six weeks, so that at the end of this time the apparatus may be removed, and the fracture carefully examined. If the bone feels firm the limb should be left at rest between sand-bags for another fortnight, when the patient may get about upon crutches; or a plaster of Paris or other rigid bandage having been applied, he may be allowed to be on crutches at once, though for the next two months he should bear but little weight upon the limb. Before the case is finally dismissed, the surgeon should see that the knee is freely movable. If stiff it should be subjected to manipulation-movements, and, if necessary, an anæsthetic should be employed, though this is seldom required.

In children, fractured shaft of the femur is best treated by the application of four short splints to the thigh, and extension by a four or five-pound weight suspended by the stirrup, as above described. A long splint should be applied on the opposite side, to keep the child at rest on his back, while sand-bags are placed along the inner and outer side of the injured limb; or Thomas's splint, which answers very well, may be employed. To the use of plaster of Paris or other rigid splints, the same objections which were mentioned in the case of adults apply in the case of children; while the leather splint, buckling round the thigh like a wide collar, which some have recommended, is a very imperfect appliance, seeing that the thigh is short and fat, and that the femur is deeply surrounded by soft parts. Hamilton uses two long splints, one for each limb, fastened together by means of a cross-bar connecting their lower ends; with this he considers that no extension is generally required. Bryant's splint is a convenient modification of this contrivance. Union is complete in four or five weeks, and after this period has elapsed the limb should be kept for a fortnight in a plaster of Paris or some other rigid case.

Lower End.— Fractures of the lower end of the femur, which are situated entirely above the condyles, may be either transverse—but this is rare—or oblique in any direction, their most usual course being from above downwards, and from behind forwards. Another group includes those which involve the knee-joint. In some of these cases, as the result of kicks, blows, or other direct violence, a part or the whole of the condyles is detached from the shaft; while in others, produced generally by falls on the knee, the two condyles are not only separated from the shaft, but are also split asunder by the wedge-like action of the patella. This injury closely resembles the T fracture of the lower end of the humerus, where in falls on the elbow the olecranon acts so as to split the lesser fragment into two lateral pieces. In transverse fracture the shaft is sometimes driven into the cancellous tissue of the lower fragment. Diagnosis is usually readily made. When the joint is involved there is generally distension of the synovial cavity by effused serum and blood. The condyles, one or both, are found to be movable on the shaft, and an increase in the width of the lower end of the bone, or some irregularity in its outline, is detected. Crepitus may be felt by moving the condyles in an antero-posterior direction, or by rotation of the leg.

Prognosis.—As fractures of the lower end of the shaft are generally oblique, and attended with considerable displacement, it is difficult to avoid shortening. This, even after very careful treatment, will sometimes amount to an inch and a half or even two inches. When fracture passes through the condyles and involves the joint, the normal outline of the articular surfaces is lost. Sometimes, after the acute inflammation of the joint which follows the injury, fibrous or even bony anklyosis occurs. Any of these conditions, coupled with shortening, greatly impairs the function of the limb, and produces permanent lameness.

Treatment.—Fractures above the condyles are, like fractures higher in the shaft, best treated either by the long splint, with the addition of short splints if these seem to be required, and extension by means of a weight of from ten to twenty pounds; or one of the other methods already mentioned may be employed. In fractures involving the joint, the fragments must be as far as possible restored to place by manipulation, the patient if necessary being placed under an anæsthetic. When reduction has been effected, the limb should be placed on a back splint and swung by the method described under Leg, Fractures of the. The back splint, however, must extend for some distance up the thigh. Or the limb may be placed in a raised position in Gant's apparatus for excision of the knee, which consists of a simple straight back splint, and a long outside splint extending from the trochanter to the foot and interrupted at the knee; or the long splint and extension may be used. In some examples the fragments remain in position best when the limb is placed on the double inclined plane. When the joint is much injured, an icebag should be applied, and care must be taken to avoid all constriction of the limb above. Should the joint be tensely distended, it may sometimes be advisable to aspirate it; but as this is a proceeding which may be followed by serious results, the cases in which it should be performed must be very carefully selected, and every care, during the operation, must be used. Passive movement should be commenced at the end of five weeks, and be carefully followed up; but no undue force must be used. The operator will find it most convenient to use his own knee, placed behind the patient's joint as a fulcrum, and then to flex the leg, slightly at first, and by degrees to carry it through its full normal range.

Should the patella be adherent to the condyles, forcible flexion would lead to rupture of the ligamentum patellæ.

Separation of Lower Epiphysis.—An injury closely resembling fracture through the condyles consists in separation of the lower epiphysis from the shaft. This accident is very rare, and can occur only in those who are under the age of twenty, for after this period consolidation of the bone is complete. Very few, if any, cases, however, have been recorded in subjects above sixteen. The injury may result from the passage of a wheel or other direct violence; but it is generally produced indirectly, by a wrench or twist; in one case it was caused by a rope in which the limb was entangled. Although the epiphysial line is above the level of the synovial membrane, the articulation is often involved through laceration of the intervening soft parts. Sometimes a vertical fracture between the condyles—of course entering the joint—is present. The amount of displacement varies. Sometimes it is so slight that the injury may easily escape notice, or be mistaken for a mere traumatic synovitis. In other instances the epiphysis is thrown completely in front of the lower end of the shaft, which projects backwards into the popliteal space. The other symptoms are pain, swelling of the joint, and crepitus; the latter, however, is often very indistinct. In some cases the popliteal vessels have been compressed by the backward projection of the bone, and the limb has become gangrenous, so that amputation has been necessary. When displacement is complete, it may be impossible to effect reduction, and amputation may be called for, though it ought not to be resorted to until it is clearly proved that the limb is useless. If displacement can be corrected a satisfactory recovery will generally take place, though, in some cases, the joint becomes stiff, or shortening results from arrested growth. The treatment, after reduction, is the same as that for fracture close to the condyles. When consolidation has taken place, should stiffness remain, an attempt may be cautiously made to restore movement, when the patient is under chloroform, by manipulation; but no violence must be used.

Howard Marsh.

FERGUSSON'S EXTENDING ARM-SPLINT consists of a rectangular iron splint for the inner side of the arm and forearm. The upper end of the arm portion is provided with a crutch for the axilla, against which extension may be made by means of a screw apparatus which elevates the crutch. The forearm and lower part of the arm are first fixed to the splint, and then the crutch is raised into the axilla, care being, of course, taken not to make too much pressure there. Bilton Pollard.

FIBROUS TUMOURS.—The non-malignant tumours which are classed under this heading, and the basis of whose structure is fibrous tissue, include—first, the softer fibro-cellular tumours, which may be either (*a*) diffused growths of the subcutaneous tissue, as molluscum fibrosum and the more pendulous forms of elephantiasis arabum; or (*b*) single encapsuled tumours, usually pedunculated, and found most commonly connected with the labia and external generative organs, but also seen in the neck and sometimes deeply placed between muscles. Secondly, the firm, hard fibromata, in whose composition other tissues have a share, which occur either as single or multiple growths, and are either superficial, as in the 'painful subcutaneous tumours,' or deeper, as in 'uterine fibroids,' or firmly connected with periosteum and bone, notably of both upper and lower jaws and adjacent bones.

Cause.—Beyond the circumstance that, in the case of fibrous tumours of the uterus, evidence of inheritance may be often made out, no explanation for the occurrence of fibrous tumours can be given. Elephantiasis being an overgrowth, and due to obstruction in the lymphatic circulation, cannot be adduced as a cause of fibrous tumours in general.

Pathology.—In the more pure types of fibrous and fibro-cellular tumours, interlacing bands of white fibrous tissue with scattered cells, oat-shaped or rounded, are seen under the microscope; but in the majority of fibromata these elements of fibrous tissue are mingled with oil-globules or fibres of unstriped muscular and other tissues. On section, fibrous tumours cut firmly, are white and glistening, and rather friable.

The tendency of fibrous tumours is steadily to increase, and they may reach to many pounds in weight. Some are painful, but this symptom appears to depend upon nerve-tissue entering into their composition, or upon their being subjected to compression by neighbouring fibrous structures, in which case it may even be doubted if the pain is not due to the tension upon those parts by the enlarging tumour.

These tumours seem peculiarly liable to degenerate, the production of cysts, or the occurrence of gelatiniform and calcareous deposits, being the most frequent changes; moreover, uterine fibromata are wont to atrophy when the menopause occurs.

In large pendulous tumours the skin often inflames and ulcerates, whilst the tumour itself may mortify and slough away.

Diagnosis.—Fibromata and cellulo-fibromata, when single, are usually firm to the touch, and may be even very hard; are ovoid in shape, and very imperfectly lobed, and they have a distinct tendency to be pedunculated. Even when soft, they have not that sense of fluidity which is so deceptive in lipomata, and for this reason they are unlikely to be mistaken for chronic abscess; but the hard fibromata are often supposed to be either cartilaginous or osseous growths. They occur usually in adult life, and hence a difficulty in diagnosing them from sarcomata presents itself.

Some forms of these growths are so characteristic as to be unmistakable—as, for instance, the outgrowths of molluscum fibrosum, and the pendulous overgrowths about the genital organs of elephantiasis, or uterine polypi.

Treatment.—Such tumours and growths as may be regarded as within the scope of direct surgical interference should be, of course, removed. Where this is impossible, either from the number of tumours or from position, various internal remedies, as arsenic and liquor potassæ, may be given, with fair prospect of success in certain instances; and, these failing, the author would advise electrolysis as offering a reasonable expectation of arresting the increase of the tumours. A. Willett.

FIBULA, Fracture of the. *See* Leg, Fractures of the.

FILARIA or DRACUNCULUS MEDINENSIS (Guinea-worm).—*Definition.*—A nematode worm of the genus Dracunculus, which attains to maturity in the human body, and produces the disease called Dracontiasis, the main feature of which is the formation of a subcutaneous tumour just before the exit of the worm.

Etiology.—The disease is due to swallowing the water containing the larvæ, and not, as formerly supposed, to the young worm penetrating the skin of the foot, &c., while bathing. The disease is endemic in Arabia, Hindostan, Upper Egypt, Nubia, Abyssinia, the Gold Coast and coast of Guinea, and a few other places.

Symptoms.—The worm gives rise to no symptoms until it is nearly mature, when it may be felt under the skin like a coil of string. When about to escape, in a mild case, a circumscribed pea-sized tumour is formed, not always at the place where the worm was first observed, with itching and a feeling of tension; the tumour ruptures, either from scratching or poulticing; a serous fluid escapes, and the white head of the worm can then be seen at the bottom of the cavity; it is usually soon protruded, and, if properly managed, the whole worm is removed in from three to ten days. In more severe cases violent inflammation may occur along the whole worm-track, and a painful abscess is then formed, with smart febrile symptoms, and the worm may die and be so softened that it breaks during extraction—a very serious accident, whether it is alive or dead, which may lead to crippling gangrene, or even death, due it is supposed, to the escape of the embryos into the tissues, and the setting up thereby of violent inflammation. In more fortunate cases the worm is discharged at a later period by the formation of a fresh tumour. The point of exit is, in over 90 per cent., in the lower extremities, usually from some part of the foot, especially the heel, but in exceptional cases has occurred from almost every part of the body. As a rule there is only one worm, but two are not uncommon, and as many as fifty have been recorded.

Pathology.—The female worm, which is alone concerned in the production of the symptoms, is one-tenth of an inch thick, and from 1 to 6 feet long, the usual size being from 25 to 30 inches, with a curved pointed tail, and a slightly convex head. It is viviparous, enclosing an enormous number of embryos which, after their escape from man, if they get into water, penetrate a minute crustacean of the genus Cyclops and undergo their full larval development; the Cyclops host is swallowed, the larvæ develop, conjugate, and then the female sets out on her migrations into the muscles, &c., while the male, it is supposed (it has never been seen) dies, and is cast out with the fæces. The female undergoes further development in the deep tissues, but it is nine or ten months from the time of her entrance into the body before she appears at the surface.

Diagnosis.—This can only be made when the worm can be felt under the skin, and is confirmed if it migrates while under observation.

Prognosis is favourable as a rule, if the worm is not broken in abstraction, or unless unusually violent inflammation occurs along the worm-track.

Treatment. — The tumour or abscess should be poulticed to facilitate its opening, and the worm should then be seized and very gently drawn out, as far as it will readily come; the end is then wound round a piece of stick, and a turn or two carefully given every day, until the whole worm is extracted, the greatest care being exercised not to rupture it. Horton recommended large doses of assafœtida, to kill the worm before the cavity was opened, and then poulticing, a plan which answers very well. When the worm is broken, and violent inflammation ensues, this must be treated on ordinary surgical principles, amputation of the limb being sometimes necessary when gangrene has occurred.

H. Radcliffe Crocker.

FILARIA SANGUINIS HOMINIS.

Historical Résumé.—In 1866, Wucherer, at Bahia, discovered, in the urine of a patient suffering from hæmato-chyluria, living microscopic nematode worms (embryo filariæ). In 1868, Salisbury described, under the title of Trichina Cystica, nematode worms he had found in the milky urine of an insane patient. In 1870, Dr. Spencer Cobbold found, in the hæmaturic urine of a young girl from Natal, besides the ova of Bilharzia, not only embryos but ova of a næmatode worm, but was doubtful of their significance. In 1870, Dr. Timothy Lewis found in the chylous urine of a patient at Calcutta microscopic nematode worms in a living state, which, on being sent to England, were classified by Dr. Parkes and Mr. Busk as belonging to the Filaridæ. In 1872, Dr. T. Lewis discovered minute nematode worms, in a state of great activity, on a slide containing a drop of blood obtained from the finger of a Hindoo. These he recognised as identical with those he had previously found in the chylous urine. The man whose blood contained the worms could not be subsequently found, so that nothing could be ascertained as to his past history, nor of the pathological conditions which may have been associated with their presence. This hæmatozoon Lewis named *Filaria Sanguinis Hominis.* He subsequently found filariæ in the blood of many patients, and in the various tissues and secretions of a number of others, all of whom were known to suffer, or to have suffered, from chyluria, or some closely-allied pathological condition. They have since been found by different observers within tolerably well-defined geographical limits.

The surmise of Dr. Cobbold, from the discovery of ova in blood sent from Australia, that the hæmatozoa were the embryos of a larger worm probably inhabiting the lymphatic system, was confirmed by the discovery of the parent worm, in 1876, by Dr. Bancroft, at Brisbane, and a few months later (1877) by Lewis in India. Parent worms have also been found, in all cases in lymphatics, by Manson in China, and by Aranjo and Los Santos in Brazil. From Bancroft being the discoverer of the parent worm, Dr. Cobbold named it *Filaria Bancrofti*, but, by general consent, the name given by Lewis (who, moreover, was the first to supply a proper diagnosis and anatomical description of the mature worm), to the hæmatozoal embryo—*Filaria Sanguinis Hominis*—has been adopted. It was further ascertained by Manson, in 1878, that the mosquito acts as an 'intermediary host,' the embryos sucked up, with the blood containing them, by the female mosquito undergoing developmental changes in its body. In 1880, Manson made a further important discovery, viz. that the embryo filariæ are not present in the circulation during the whole twenty-four hours, but that they disappear in the daytime and reappear each evening. These observations have been confirmed by Dr. Wykeham Myers, at Formosa, and by the writer, and the latter has further shown that this 'periodicity of filarial migration' is in some way connected with the moving and resting condition of the host. Lastly, Manson, from observations of his own and others, that ova sometimes escape prematurely from the female parent, has advanced a theory of the pathological changes induced by filarial infection, which unites the various maladies associated with the presence of filariæ in the human subject, and at the same time explains how the parasite may exist in the lymphatics and the embryos in the blood without any marked manifestations of its presence. The pathology of these diseases has also been elucidated by Dr. Vandyke Carter, Lewis, Sir Joseph Fayrer, and others.

The Mature Filaria Sanguinis Hominis.—The female is a fine, thread-like worm of white colour, about 3 to 3½ inches long and about $\frac{1}{100}$ of an inch wide. The body is of uniform thickness, and the cuticle smooth and devoid of transverse markings. The head is club-shaped, with simple circular mouth, destitute of papillæ. The vagina opens about $\frac{1}{25}$ of an inch from the head; it is very short, and bifurcates into two uterine horns, which run backwards nearly to the tail, and in the fecundated condition are stuffed with embryos at all stages of development. The following careful measurements by Lewis will serve for identification :—

	of an inch		mm.
Oral aperture to end of œsophagus . . .	$\frac{1}{55}$	or	·45
Diameter of oral aperture	$\frac{1}{3000}$	,,	·008
Width of neck . . .	$\frac{1}{545}$	,,	·045
,, about ¼-inch from anterior end . . .	$\frac{1}{153}$	,,	·162
Width where packed with ova and embryos . . .	$\frac{1}{100}$	,,	·25

The entire male has not yet been obtained, but a portion ½-inch in length, examined by Lewis, measured $\frac{1}{180}$ of an inch transversely; it was thinner than the female, but of firmer texture, and manifested greater tendency to coil. The intestinal canal measured $\frac{1}{633}$ of an inch across, and the spermatic tube $\frac{1}{1500}$ of an inch.

The female is viviparous, the embryos, having stretched their chorional envelopes, emerging from the vagina and manifesting active movements. Parturition appears, from observations by Manson, to be a continuous and not an intermittent process.

The *ova*, fully formed, measure about $\frac{1}{500}$ by $\frac{1}{750}$ of an inch.

The *embryos*, measuring from $\frac{1}{75}$ to $\frac{1}{90}$ by $\frac{1}{3200}$ to $\frac{1}{3500}$ of an inch, are fine thread-like worms of a uniform thickness, with rounded head and tapering tail. They are translucent and apparently structureless, but Manson describes a kind of pouting movement noticeable at the anterior extremity. The embryo is enclosed in a delicate sheath, which is often difficult to detect. When, however, the embryo has been kept for some time on a microscope slide, the body shrinks, and the sheath becomes very manifest; the animal, shortening its body, retracts itself from the superfluous envelope at one or other extremity, and again on stretching itself occupies the previously empty sac. The sac is sometimes seen folded on itself ribbon-like. The sheath is easily demonstrated by staining reagents.

The embryo, when freshly removed from the body in a drop of blood, exhibits lively eel-like movements, coiling and uncoiling its body, and lashing the blood-corpuscles by which it is surrounded. It may be kept alive for many days in a drop of blood on a slide, simply mounted with a cover-glass, especially if the edges of the preparation are prevented from dessication by a film of oil or paraffin. Under these conditions, after a time, its movements become less and less active; from being coiled its body becomes gradually extended and straightened; then only feeble movements of the extremities occur from time to time, and finally these cease. When dead, the body is nearly always more or less extended, assumes a granular appearance, and is often partly retracted from the sheath. When a slide containing a number of embryos is watched day after day, some of them disappear by a process of solution. The embryos are best searched for by a one-inch or half-inch objective, and when present, usually, if the examination is made at night, from 10 to 100 may be counted on a slide. · The number circulating in the blood in most cases must be enormous. From the number counted in a cubic millimetre of blood, in a case under the care of the writer, it was computed that the patient's blood contained from 36,000,000 to 40,000,000 at the maximum at night.

Habitat of the parent and embryo filariæ.—It has been established by the observations of Bancroft, Lewis, Manson, and others, that the parent worms are located in the lymphatics, the two sexes living together. Apparently any part of the lymphatic system may be occupied, but the abdominal, iliac, scrotal, spermatic, and femoral regions seem to be involved more frequently than other regions. When the lymphatic channel is free and unobstructed, the embryos emitted from the parturient female into the lymph-stream pass with it along the thoracic duct to its termination, where they finally reach the blood. Should, however, the lymphatic channel be occluded at any point proximal to that inhabited by the parent worms, the embryos will be confined to the distal side of the obstruction, and will not reach the blood.

Filarial Periodicity.—In ordinary circumstances when the blood of a filariated patient is examined between 6 a.m. and 6 p.m., the embryo filariæ are either entirely absent, or only one or two are found in a drop of blood. At about 6 p.m. they begin to make their appearance; at 9 p.m. they are numerous, and at midnight they reach their maximum. From this hour they again diminish, so that by 3 a.m. they are less numerous, and by about 6 a.m. they have disappeared, or a few stragglers only are found. This periodicity, which was first observed by Manson, and confirmed by Dr. Wykeham Myers, is not a habit of the filariæ confined to the tropics, but has been observed by the writer in a case in this country imported from India, and in a case observed by Dr. Lloyd Jones. The knowledge of this periodicity of filarial migration is of the highest practical importance, for, unless the blood is examined *at night*, filariæ may not be discovered, even when a patient is infested with them. The full explanation of filarial periodicity has not been arrived at; but the writer has shown that, whilst it is uninfluenced by the hours at which regular meals are taken, it is in some way connected with the moving and resting (or sleeping) condition of the host. For, in a case under his observation, he was able, by turning the patient's day into night and night into day, to invert the periodicity, so that the filariæ swarmed into the blood in the daytime when the patient was at rest, and almost or entirely disappeared from the blood at night when the patient remained up and moving about. This observation has been confirmed by Dr. Manson, who has further shown that prolonged sleep probably disturbs periodicity and diminishes the number of embryos circulating at the time of maximum, and that when the usual allowance of eight hours' sleep is taken in spells of four hours at a time, at intervals of eight hours, periodicity is disturbed, and the numbers circulating at the time of maximum are sensibly diminished. The periodicity is further influenced by the febrile state. When pyrexia is present the periodicity is disturbed—not immediately, but after it has lasted for some days; in a similar manner, the regular rhythm of filarial migration is not re-established immediately on the cessation of the increased temperature of the body, but only after the fever has ceased for some days.

What becomes of embryo filariæ when they disappear from the general blood-stream, is not known. Dr. Manson suggests that they repose in the blood-vessels of the lungs, or some other blood-reservoir, during the day. Dr. Wykeham Myers has advanced the view that the embryos found in the blood each night are a separate brood, which perishes in the morning, to be replaced by a new brood the next night. This view is mainly founded on his observations as to the activity and viability of the embryos on removal from the body, at the hours when they enter and leave the general circulation. Dr. Myers asserts that, whereas those found in the blood in the evening are invariably strong, active, and long survive their removal from the body, those found in the blood in the morning are feeble, lethargic, and survive their removal from the body for a shorter time than the evening embryos. Dr. Manson has not been able to confirm Myers' observations. This theory of a diurnal brood necessitates intermittent parturition, and the issuing of a fresh swarm from the parent every twenty-four hours. In opposition to this, Manson has shown that the parturition of the adult female is a continuous and not an intermittent act. It is further thought by Cobbold, and others competent to judge, that the enormous number of embryos in the blood precludes the possibility that they could be a single brood, even assuming that several fertile females are present.

The rôle of the mosquito.—The discovery that the mosquito acts as an 'intermediary host' to the filaria sanguinis hominis—that is, that whilst in the body of the mosquito certain developmental changes take place in the embryo which fit it for its ulterior destiny—made by Manson, has been confirmed by others. It has not been clearly ascertained whether this office is confined to a single species of the culex, or whether several species are capable of performing it; but it is certain that some species of mosquito are impotent to assist the embryo, digesting them but not nurturing them. The fact that all mosquitoes are not efficient in this respect may be an explanation of the limitation of filarial infection and its results in regions quite near together. The mosquito feeds by night—the female only sucks blood—and the periodicity of filarial migration appears an adaptation of nature to allow for the removal of the embryos to complete their cycle of development. Further, there seems to be a mutual adaptation between the perforating instrument of the mosquito (the proboscis) and the shape and character of the movements of the embryos, so that when the proboscis penetrates a blood-vessel the embryos become entangled around it, or attracted to it; and thus a drop of blood from the freshly-gorged mosquito is found to contain a larger number of embryos than a drop of the blood obtained from the bitten subject. Received into the stomach of the mosquito, some of the embryos are digested even by the friendly mosquito, but others perforate the thorax of the mosquito and commence a series of changes. These have been studied with great care and detail by Manson. That certain developmental changes of the embryos take place in the body of the mosquito, has been established by Lewis, Bancroft, and Sonsino, but the later shades of development described by Manson have not yet been confirmed.

Most mosquitoes lay their eggs and die during the fifth or sixth day after feeding, so that the final stage is difficult to trace. What becomes of the filariæ after this stage can as yet be only conjectured. The mosquito lays its eggs upon the water and soon after dies, its body probably falling into the water. The embryo probably perforates the body of the dead or dying mosquito, or is liberated by its decomposition, and escapes into the water, for which medium it is admirably adapted. It is, further, in the highest degree probable that the metamorphosed and free embryo gains access to a fresh human host through the medium of drinking water, and on arriving in the alimentary canal perforates its way, by that kind of elective affinity which leads the trichina to the muscles, the liver-fluke to the bile-ducts, the strongylus-gigas to the pelvis of the kidney, &c., to some lymphatic, where it grows to adult size, is impregnated by the male, and sends forth a fresh progeny to perpetuate the species.

The geographical distribution of Filaria Sanguinis Hominis, and prevalence in infected regions.—The exact distribution of the parasite has not been absolutely determined, but judging from the diseases attributed to its influence, this is probably well-defined. It is an inhabitant of tropical and sub-tropical climates, and its limits are probably co-extensive with chyluria, so often due to it, and which Lewis states occurs, with rare exceptions, between 30° south and 30° north latitude. With regard to its prevalence, Manson has shown that at Amoy and the surrounding districts, amongst patients applying for treatment for miscellaneous diseases, and in their relatives and friends not themselves diseased, filariæ are found in the blood in about one in ten persons examined, and that, allowing for their occasional absence, one in eight persons are probably so affected. At Bahia, Drs. Paterson and Hall found filariæ in one in twelve, but from the insufficiency of the examinations, they calculate that this is an under-estimate. This, in both the above instances, is almost certainly the case, for the examinations were mostly made by day, before the nocturnal periodicity of the filaria had been discovered. Exact information on this point does not appear to have been collected in India, Australia, and other affected regions.

Both sexes are liable to be infected by the filaria sanguinis hominis, and Manson's observations tend to show that the prevalence of filarial infection increases with age.

The conditions associated with, or dependent on, filarial infection.—The above statements by Manson, Paterson, and Hall, as well as the experience of many observers in India, show not only that filariæ may be present in the blood in persons not suffering from any of the diseases attributed to the parasite, but that they may exist in the blood without any other evidence of disease. This does not militate against filarial infection being the true cause of the various morbid conditions commonly associated with their presence, for—(1), this association is too frequent to be merely the result of coincidence; and (2), an explanation can be afforded which at once accounts for the presence of filariæ in the blood without these diseases resulting, and for the production of disease in the cases in which they occur.

The diseases that have been found associated with the presence of filariæ in the blood or lymph, and have been attributed to this cause, are the following: chyluria, hæmaturia (certain forms), varicose groin-gland with lymphangitis, lymph-scrotum (nævoid elephantiasis) elephantiasis (arabum) of scrotum or legs, hydrocele and affections of the spermatic cord and testis, and 'craw-craw,' a form of skin-disease. Less certainly connected with filarial infection are—diarrhœa, cachexia, debility, deafness, and eye-disease. It is not claimed that the most typical of these are always so caused (Fayrer), but filarial infection gives an efficient explanation of the first group. With or without local disease filariated persons are liable to irregular pyrexia (elephantoid, lymphatic or filarial fever) which is often mistaken for ague. It differs from true malarial (intermittent) fever, in the irregularity of the attacks, and in the greater length of both the febrile paroxysm and interval.

Whilst many—especially Sir J. Fayrer, Lewis, Bancroft—have connected filariæ and several of the previously named diseases as cause and effect, the most complete explanation of the pathology of filarial diseases has been advanced by Dr. Manson, whose theory is as follows. The parent filariæ occupy the lymphatics, and, if the lymph-channel is free, the embryos will be carried with the lymph-stream until this commingles with the blood, whence the embryo will be carried to all parts of the body, and no disease necessarily result. If the *glands* or lymphatics traversed by the lymphatic paths are obstructed, the lymph will be dammed up, and the embryo will be confined to the distal branches of the occluded lymphatic, and not reach the blood at all.

Up to this point probably all who have had opportunities of practically studying the subject are agreed. But Manson further believes that—and this view is entirely his own—the obstruction of lymphatics and glands is induced by abortion of the pregnant female filaria. He and one or two other observers have noticed that occasionally ova escape from the female filaria. These ova, the contained embryo not having stretched the chorional envelope, equal from five to seven times the smallest diameter of the embryos, and are not capable of the propulsive movements of the latter. When the ova reach the narrow channels of the lymphatic glands, being too large to pass, they act as emboli, plug the vessels, and obstruct the lymph. 'There will then be complete stasis of lymph in this particular vessel as far back as the first anastomosing lymphatic. Along this the current will now pass, carrying with it other ova; these, in their turn, will be arrested at the first gland they reach. And this process of embolism, stasis of lymph, diversion of current into anastomosis, will go on until the whole of the lymphatic glands, directly or indirectly connected with the vessel into which the parent parasite ejects her ova, are rendered impervious, provided the supply of embolic ova is sufficient, kept up long enough, or renewed from time to time. The particular form of lymphatic disease, and the place affected, will depend on the position occupied by the parent worm, on the number of ova she ejects, on the frequency with which these miscarriages are repeated, and on the nature of the tissues involved, and individual peculiarities and accidents.'

The writer ventures to suggest that in some cases the lymphatic obstruction that gives rise to the various diseases associated with filarial infection may be caused by inflammation excited by the presence of the parent worms, without filarial abortion being a necessary step in the process. It may be further inferred that any condition which brings about mechanical obstruction of the lymphatics, of a lasting kind, will be followed by similar results, and thus may be explained what is known to occur, that the various diseases ascribed to the influence of filaria sanguinis hominis may happen without the presence of this parasite. Plugging of the upper group of the superficial inguinal glands, if anastomosis is not established, will give rise to 'lymph scrotum,' or to elephantiasis of the scrotum. If the lower group of these glands is obstructed, elephantiasis of the lower extremity may result, the two affections, from the intimate connections of these two groups of glands, being frequently associated. Where the lumbar glands are affected the lymphatics of the spermatic cord may be involved, and hydrocele, simple or milky, be caused. Chyluria or lymphuria will result when the lymphatics of the bladder, ureters, or kidneys are occluded (*see* CHYLURIA). In many of these conditions, besides chyluria, the over-distended lymphatics rupture and a discharge takes place, lymphous if no regurgitation from the lacteals occurs, chylous if such regurgitation takes place.

Prevention of the diseases attributable to filarial infection.—Whilst the exact mode of entrance of the filaria has not been established, it will be seen that in all probability it is through the medium of drinking-water. Preventive medicine may therefore be of signal service in lessening or stamping out the diseases due to this cause, by insisting that all water used for drinking purposes be filtered, or, better still, boiled.

Filariæ are not confined to the blood of man. *Filaria immitis* is very common in dogs in China, Japan, and India, and other carnivora are known to be similarly affected. Many birds also have filariæ in their blood. The common ringed crow and magpie of China are frequently infested, the parent worms being found in the pulmonary artery or valves of the heart.

STEPHEN MACKENZIE.

FINGER-CHANCRE.—Chancres may occur on any part of the body, and they are unfortunately of not infrequent occurrence on the fingers of those engaged in midwifery practice. A chancre on the finger, whatever may have been its source of origin, often presents throughout its course very deceptive appearances. As a matter of fact the true nature of these sores is but seldom recognised until the constitutional symptoms appear. In some cases this is due to the very slight amount of inflammation which attends them, but in a majority to its excess. It is probable that the finger is seldom inoculated unless there has existed previously some sore or abrasion. Their most common seat is the nail-bed, producing there what may be termed the 'whitlow-chancre.' There is nothing in their early stages to distinguish them from the sores due to common inflammation. They are attended by much dusky swelling of the end of the finger, considerable suppuration, and great pain and soreness. At no stage is there any characteristic induration. The nail often becomes loose, and may be shed or removed by the surgeon. If treatment be adopted early, however, the nail will usually be in part at least preserved, but it often remains ever afterwards rugged and thickened.

In making the diagnosis of finger-chancres the examination of the lymphatic glands is of great importance, but of course does not afford conclusive evidence, since indolent enlargements of them may occur in connection with other sores than those of syphilis. The stages of chancres on the fingers are the same as those of chancres on other parts, and the conditions are just as variable in individual cases. It is not uncommon for the period of incubation (four to five weeks) to pass over without any sore being noticed, but in other cases inflammation in varying degree may be present from the first. Now and then a finger-chancre when not implicating the nail-bed may present, even when at its height, nothing more than a dry dusky and scaly patch, and in these cases the axillary bubo may be omitted or be but very slightly marked. It is in such cases almost impossible to make the diagnosis before the appearance of the secondary rash.

Chancres may of course occur on other parts of the hand besides the fingers, but they are very infrequent. The writer has seen them more than once in the middle of the palm; and here, as on the face and some other parts, they occasionally assume extraordinary dimensions. Thus in one instance almost the whole of the palm of the hand of a policeman, who had been injured in a scuffle, was occupied by a chancre.

Although in a very large majority of cases a finger-chancre is also a 'midwifery chancre,' yet it is of course to be understood that this is not always so. A surgeon's finger may be inoculated in the performance of an operation, or in making a dressing or examination. We also now and then see professional chancres on the fingers of dentists and policemen; whilst in a yet smaller proportion they are met with, either from improper practices or as mere matters of accident, on the fingers of those whose occupations are not attended by any special risk.

For further information concerning erratic chancres in general, the reader is referred to SYPHILIS.

JONATHAN HUTCHINSON.

FINGERS, Amputations of the.—The soundness of what has been designated 'conservative' surgery receives ample illustration in connection with this group of amputations, the principle being the removal of as little of the limb as is compatible with the patient's safety and convenience. The preservation of even one or two fingers is of the last importance to the patient, from his being able to accomplish more with them than with the most elaborately constructed artificial hand. The wounds, too, owing to the great vascularity and inherent vitality of the parts, usually heal with exceptional rapidity.

The amputations of the fingers may be divided into three groups :—(*a*) The phalangeal ; (*b*) the metacarpo-phalangeal ; and (*c*) the carpo-metacarpal amputations.

The PHALANGEAL amputations may be done either between or through the articulations, or in the 'continuity' or 'contiguity' of the phalanges. The amputations performed through the articulations or in the contiguity, are those more frequently selected, and are done by a short posterior, and a long anterior or palmar, flap. The operation is performed in one of two ways. In the first, the hand is pronated, and the neighbouring fingers being separated and held asunder, the surgeon seizes the portion of the finger to be removed, and forcibly flexes it on the proximal phalanx. The articulation is then easily opened by directing a narrow-bladed scalpel or bistoury across the front of the joint. The operator can facilitate the procedure by pressing the tissues forward with his left index-finger, kept behind the part to be removed. Having divided the ligaments in front and at each side of the joint, and freely opened into it, the scalpel is brought well behind the phalanx and close to the bone, and an anterior or palmar flap of sufficient length is made by cutting from behind forwards. The articular surface of the proximal phalanx should then be removed with either a fine saw or, better still, by a bone-pliers. All bleeding vessels should be secured, and the palmar flap brought up and secured to the edge of the dorsal incision by two or more points of interrupted suture.

Another method consists in making the palmar flap in the first instance by transfixion, the hand being supinated. The articulation is opened into in front, and a short dorsal flap is then formed. The first-mentioned method is decidedly to be preferred. These operations are equally applicable to the amputation of the terminal and second phalanx ; the great merit of the procedure being its facility, the ample covering for the bone that is obtained, and that the cicatrix, situated on the dorsal aspect of the finger, is not liable to be injuriously affected by pressure. When possible, amputation in the continuity of the second phalanx is to be preferred, with the object of preserving muscular attachments, and a consequent power of motion in the first phalanx.

Amputations in the continuity are applicable both to the first and second phalanges. They may be done either by antero-posterior flaps of equal length, or by lateral or circular flaps. The first-mentioned is the one most usually selected. The hand being prone, the operator grasps the finger to be removed, and with a narrow-bladed scalpel or bistoury makes a lunated incision over the dorsal aspect of the finger, and a flap from a quarter to half an inch in length. A palmar flap, somewhat longer than the dorsal, should be made by transfixion. The bone is then cleared and divided, either with a fine narrow-bladed saw or preferably with a cutting pliers. The method by lateral flaps is mainly applicable to amputations of the first phalanx, and may be made either by transfixion or dissection. In this operation the surgeon must exercise his own judgment as to the removal or not of the head of the metacarpal bone. As a rule the writer prefers removing it.

The operation best adapted for the next group of digital amputations, METACARPO-PHALANGEAL, is the 'oval' method, so called in consequence of the wound made being somewhat of an oval shape. It consists in making an incision on the centre of the dorsal aspect of the metacarpal bone, commencing a few lines behind the point where the bone is to be divided. The knife, on approaching the head of the metacarpal bone, should make an oval sweep round the finger, following in so doing the natural somewhat transverse crease or groove on the palmar surface, great care being taken to avoid wounding the web of the fingers, the formation of any palmar cicatrix being most undesirable. The tissues on, and at each side of, the bone, are then divided, care being taken not to open into the articulation with the first phalanx. Another point of importance connected with amputations of the fingers with portions of their corresponding metacarpal bones, is in reference to the way these latter are divided. If the 'ring' or the middle finger be operated on, the bone should, as a rule, be divided horizontally in a line at right angles to its axis. If, on the other hand, the fifth or little finger, or, again, the 'index' finger be operated on, the division of the bone should be made obliquely, in order to prevent deformity and the pressure of any sharp edge of bone on the integuments covering them. In dividing the metacarpal bone of the little finger, therefore, the division should be obliquely from behind forwards and inwards, and the direction should be reversed in operating on the index fingers.

CARPO-METACARPAL AMPUTATIONS. — With the exception of the amputation of the thumb, these amputations are seldom performed, for the sufficient reason that the operations involve opening the synovial membrane of the wrist, an occurrence which—no matter how careful the antiseptic precautions taken may be—is fraught with considerable peril to the joint.

Amputation of the *thumb* is, of all the amputations on the fingers, the one which the surgeon should be the least disposed to perform. It is only in cases of the most urgent necessity that it should ever be undertaken. The reason for this is that of all the digits it is the one the preservation of which is most important for the patient. By some of the older French authors, it has been well termed *le petit main.* The complete removal of it, therefore, with its metacarpal bone, should be regarded in the light of a *dernier ressort.*

It may be performed in one of three ways:—(1) the oval method; (2) the method of transfixion; and (3) the method of 'direct incision,' i.e. separating the thumb from the other fingers, thus making the web tense, and then dividing this by cutting directly down through it, keeping close to the metacarpal bone until the articulation with the trapezium is reached. This joint is then opened, and the bone disarticulated. A lateral flap is then made by getting the knife behind the bone, and cutting a flap from behind forwards. The great disadvantage of this operation is that a long and often painful palmar cicatrix is left. In fact, the operation has little to recommend it, with the exception of the rapidity with which it can be performed.

The oval method is performed in a manner similar to that already described in connection with the metacarpo-phalangeal amputations. The procedure is one which, though it necessarily takes a much longer time for its performance than the other methods, still is one which, as a rule, is attended with very satisfactory results. The wound made in this operation is not so extensive as in the method by direct incision, and it has the additional merit of there being only one cicatricial line, and that far removed from the palmar surface.

The third and last method deserving of mention is that known as the one by transfixion. It is performed with a small catlin. An oblique incision is made along the posterior aspect of the thumb, dividing integument, long extensor, and a portion of the first interosseous muscle. The incision commences at the centre of the commissure, and extends to a point terminating in front of the styloid process of the radius. Here transfixion of the tissues forming the 'ball' of the thumb occurs, the point of the instrument being made to enter at the termination, and emerge at the commencement of the oblique dorsal incision. The flap is then made by dividing the tissues from within outwards, keeping close to the metacarpal bone.

The capsule of the joint is opened, the bone dislocated and removed. This operation is also performed by reversing the steps of it as already indicated, making the transfixion flap in the first instance, and the oblique dorsal incision afterwards. The procedure is a slight modification of the procedure described by Velpeau.

The oval method is, in M. Guérin's opinion, from every point of view the one to be preferred, and in this the writer is disposed to coincide. The same opinion may also, he thinks, be given as regards amputation of the little finger with its metacarpal bone. This operation is performed in two ways:—(1) the flap method (Lisfranc), and (2) the oval. The former of these is performed by making a flap by transfixion by means of a full-sized triangular bistoury, which is the instrument usually employed. It should be inserted, Malgaigne observes, opposite the ulnar side of the joint perpendicularly from the dorsal to the palmar surface, and a semi-elliptical flap formed by cutting from behind forwards. The knife, keeping close to the bone, should divide the interosseous tissues, cutting from behind forwards to the digital commissure. The joint should then be opened, and the bone dislocated. On making traction of the finger, the ligamentous and muscular tissues, as yet undivided, are made apparent and incised by a few touches of the point of the bistoury. A simpler and better method—that by direct incision through the web of the finger and interosseous space—has been thus described by Mr. Heath: 'The finger being drawn away from the hand, the knife, held at right angles to the finger and with its point upwards, is made to cut through the web of the finger and interosseous space until it reaches the base of the metacarpal bone. This is somewhat expanded, and the knife must be turned outwards slightly to open the joint, when forcible traction of the finger will dislocate it. The knife is then passed round the base of the metacarpal bone, and brought out with the edge forwards, cutting a flap from the ulnar side of the finger, rather longer than the exposed surface, in order to allow for shrinking.'

In the writer's opinion, for amputations in the contiguity of the phalanges, the method by a short posterior and long anterior flap is to be preferred; in amputations in the continuity, antero-posterior flaps of equal length; and in metacarpo-phalangeal and carpo-metacarpal amputations, the oval method should be the operation selected. William Stokes.

FINGERS, Congenital Deformities of the.—The more common among the congenital deformities of this region range themselves naturally into two classes—namely, those of excess and those of deficiency. In a very large proportion of instances there is some history of inheritance, and the story, when accurately to be obtained, is often of considerable interest, and may show the existence of similar, though not always identical, deformities in many generations. Extra digits are among the most frequent of all aberrations of type occurring congenitally. Every variety is to be met with, from a small piece of flesh resembling the last phalanx and provided with a rudimentary nail, which is attached by a minute thread of skin to some portion of the outer side of the thumb or the inner side of the little finger, to the perfectly developed digit or digits provided with an additional metacarpal, and even in some cases an extra carpal bone. Sometimes such fingers have special tendons and are accommodated with an efficient vascular system. More commonly, however, their usefulness is very slight and their nourishment but imperfect. The condition may be unilateral or symmetrical, and additional toes may co-exist in the same individual. These are the two extremes of the deformity, but intermediate conditions are frequent, as when an extra phalanx articulates with the distal end of the second phalanx, or where an additional finger articulates by a common joint with the metacarpal, which is then expanded at its extremity, or, in some cases, bifurcated, Where a separate articulation exists it is usually placed below the normal articular surface of the metacarpal or phalangeal bone. Sometimes—and this is especially frequent in the case of the thumb—the extra digit is intimately united along its whole length with the normal finger, and the two move and act freely together.

On the side of deficiency there is met with again every gradation of variety. A finger may be represented by a single phalanx, or all the fingers of the hand, and even the hand itself, may be absent. The thumb, although less often deficient, may be only partially represented, and the little finger, though less frequently absent than others, is often only rudimentary. Not uncommonly all the parts on the ulnar side of the hand may be unrepresented, together with the corresponding metacarpal, and even carpal, bones, and in such cases more or less deficiency of the ulna itself will be detected. The same condition is found, though not so frequently, on the radial side. These cases must be distinguished from those of so-called intra-uterine amputation, which may occur at any part of the hand or arm, though even in these some representative of a digit is very commonly discovered.

Treatment.—The only remedy which may be called for in cases of extra digits is to amputate the part which is excessive and useless. In doing so, it should be remembered that there is usually a common articulation to both the normal and abnormal portion, and, therefore, that it may be impossible to avoid opening the synovial membrane of the former. Even the smallest skin attachment transmits an artery which will require careful ligation. No portion of bone should be left behind, as this will inevitably grow and cause an unsightly and inconvenient prominence. *See* Webbed-Fingers. John H. Morgan.

FINGERS, Dislocations of the. *See* Hand, Dislocations of Bones of the.

FINGERS, Fractures of the. *See* Hand, Fractures of Bones of the.

FISSURE OF THE ANUS.—The affection of the anus usually known by this name is really an ulcer of the mucous membrane, at or immediately above the margin of the anus. The ulcer is somewhat oval, with the vertical diameter greater than the transverse. When the sphincter muscles are contracted, the ulcer is bounded on each side by a projecting fold of swollen and, in chronic cases, indurated mucous membrane, and so resembles a fissure. When the orifice is dilated, the true nature of the case is evident. The lower end of the ulcer is, in many cases, overlapped by a protuberance of mucous membrane, which resembles, and is sometimes mistaken for, a muco-cutaneous pile. The ulcer is generally situated on the posterior wall of the anus, and occurs more frequently in females than in males. It is comparatively rare in children.

A sedentary life, congestion of the rectum, and constipation are predisposing causes. It sometimes results from parturition. During the passage of the child's head through the vulva, the margin of the anus may be slightly lacerated, and the subsequent irritation of the lochial discharge may cause ulceration. Catarrh of the rectum—whether simple or caused by a polypus, internal piles, or a fistula, or, in women, vaginal discharges—may cause excoriation and subsequent ulceration of the margin of the anus.

The symptoms vary in different cases. Some patients feel merely some irritation or uneasiness during the passage of a motion. In others, defecation is attended with excruciating pain, which may last for several hours. Not infrequently there is intense spasm of the sphincter and levatores ani muscles. The muscles at the neck of the bladder may be similarly affected, and so produce retention of urine. In patients of irritable nervous temperament, this apparently trifling ulcer may cause unceasing torment, and the sufferers complain, not only of local distress, but also of pains in the lumbar and sacral regions, and down the thighs. The anatomy of the part explains these symptoms. The submucous tissue of the rectum is abundantly supplied with a nervous plexus, the terminal branches of which end in the papillæ and epithelium of the mucous membrane. When the surface is ulcerated, these nerve-terminations are exposed, and, when irritated by the passage of fæces, or by mucous or purulent discharges, or even by the tension produced by the contraction of the muscles of the part, may induce reflex spasms and local or referred sensations of pain. As some of these symptoms occur in so-called neuralgia of the rectum, the diagnosis can only be assured by inspection of the part. For this purpose, if there be much spasm, or if the patient be very sensitive, anæsthesia must be induced. The orifice being then dilated by the fingers of the surgeon, or by a Fergusson's speculum, the ulcer, if present, will be seen. The rectum should be carefully examined, to ascertain whether there are any complications, such as catarrh, polypus, piles, or fistula. If there be any of these, or if, in women, there be a vaginal discharge, the complication must be appropriately treated as well as the ulcer.

For the ulcer itself, if it be recent and the symptoms not severe, cauterisation with solid nitrate of silver, and the subsequent application of iodoform in powder, or as an ointment, will usually suffice. If this treatment fail, or if the ulcer be chronic or the symptoms severe, operative treatment will be required. The bowel having been previously emptied, the patient should, if necessary, be anæsthetised, and placed in a suitable position, the lithotomy position being usually the most convenient. The orifice having been dilated by the fingers of an assistant, or by a Fergusson's speculum, a vertical incision should be made along the centre of the ulcer, extending into the healthy tissues above and below it. Any overlapping protuberance of mucous membrane, at the lower end, should be excised. By this incision the mucous membrane and the superficial fibres of the sphincter muscles should be divided. The ulcer may then be dressed with cotton wool steeped in carbolised oil, and subsequently with iodoform. The patient should maintain the recumbent posture, and the bowels be kept at rest for some days. About the fifth day some castor-oil should be administered, to produce an easy action of the bowels. The ulcer usually heals rapidly by granulation, but may require some stimulating application, such as dilute nitrate of silver lotion.

It was at one time considered necessary to completely divide the sphincter muscles. In order to avoid this needlessly formidable operation, the practice of forcible dilatation was adopted. The surgeon having introduced both thumbs into the bowel, resting his fingers on the nates, then separated his thumbs until they came in contact with the ischial tuberosities. By this means the base of the ulcer was torn across. This practice was given up when it was ascertained that superficial division of the sphincters sufficed. It has been recently revived by some surgeons, but does not appear to have anything to recommend it in preference to the limited incision above described.

Jeremiah McCarthy.

FISTULA IN ANO.—This is a sinus in the neighbourhood of the anal part of the rectum, of which three varieties have been distinguished:—The Complete, opening into the bowel internally, and on the perineum externally; the Incomplete External, opening on the perineum but not into the bowel; and, the Incomplete Internal, opening into the bowel but not on the perineum. The second and third varieties are very rarely met with, and the diagnosis of the second should only be made after careful examination, as the internal opening may be small, and concealed by a fold of mucous membrane; or the sinus may travel round the rectum, in the so-called 'horse-shoe' form, and open on the wall of the bowel remote from the perineal aperture. If an internal opening cannot be detected in the ordinary way, by the passage of a probe into the sinus with one hand, and of the opposite forefinger into the bowel, the patient should be placed in the lithotomy position, and a Fergusson's speculum introduced into the rectum, with the slit directed towards the wall of the bowel adjacent to the perineal opening of the sinus. Some milk should be injected, under moderate pressure, into the sinus; and if none pass into the bowel, while the injection is still continued, the speculum should be slowly rotated so as to bring the slit successively opposite to all parts of the circumference of the bowel. Then, if milk pass into the bowel, an internal opening will be discovered, which might otherwise have been unnoticed, or, on the contrary, the absence of any opening can be satisfactorily ascertained.

Cause.—Anal fistulæ result from suppuration of the peri-anal connective tissue. This may be due to perforation of the mucous membrane by some foreign body, such as a fish-bone, or by ulceration. It may also occur without any lesion of the mucous surface, possibly in connection with the lymphatics, or blood-vessels, or glands of the part. If a free opening be made in the perineum as soon as fluctuation can be detected, the wound will probably heal without further trouble; but if the abscess be neglected, as is often the case, since it causes little pain, it will ultimately point and open in the perineum, generally on one side of the anal orifice, but sometimes in front of or behind it. The abscess-cavity then contracts, but cannot close completely from the constant traction of the anal muscles. The internal opening, if not already existing, will form subsequently, and if the contents of the bowel can pass into the fistula, healing will be still further prevented. The inner opening is usually at some point within the limits of the internal sphincter, which extends upwards to about one inch from the orifice. The inner opening is very rarely higher than this, and in the majority of cases will be found close to the margin of the anus. The channel connecting the openings may be straight or tortuous. It sometimes passes round the bowel, as the so-called 'horse-shoe' fistula. In chronic cases secondary sinuses often form, which may ramify in any direction, so that there may be more than one perineal or internal opening.

Symptoms.—Anal fistulæ are painless, so long as the discharge can escape freely. If the external opening become occluded, the part will inflame; but the patient is chiefly inconvenienced by the surrounding parts being kept always moist and soiled by the discharge. The discharge itself may vary in quantity and character, being scanty or abundant, serous or purulent, according to the patient's general condition and the irritability of the part. Sometimes flatus, or even fæces, pass by the fistula, especially if the inner opening be large.

Diagnosis.—All perineal fistulæ in the neighbourhood of the anus are not necessarily connected with the anus. They may be due to stricture of the rectum, or to necrosis of the sacrum or coccyx, or to stricture of the urethra, or to disease of the prostate gland. The history of the case, the direction of the sinus, and examination of the surrounding parts, will sufficiently distinguish these from an anal fistula. In chronic cases the perineal opening is usually marked by projecting granulations, but in recent cases this indication does not exist, and the surgeon may have to search closely for the orifice, if it be small and concealed by folds of skin round the anus. The direction and extent of the fistula may be ascertained by the cautious use of a probe, and injection, as above described, may, if requisite, be used to discover the internal opening.

Treatment.—The only curative treatment that can be recommended is complete division of the structures between the fistula and the anus. This may be performed as follows:—An aperient should be administered the evening prior to the operation, and if the patient be a male adult, the perineum should be shaved. The patient should be placed on the side corresponding to the fistula, with the thighs flexed or in the lithotomy position. If the fistula be recent and simple, and the patient not very sensitive, an anæsthetic will not be requisite. But in chronic cases, where secondary sinuses may be present, the operation can be performed more satisfactorily if the patient has been anæsthetised. The direction of the fistula having been previously ascertained, a suitably curved director should be introduced through the perineal orifice, and brought out at the anus. A sharp-pointed bistoury, passed along this, should then be made to cut through all the intervening structures.

The angles of the wound, and any undermined skin or mucous membrane, should be excised, and an incision made with a scalpel along the upper wall of the fistula, to divide the callous cicatricial tissue which forms the boundary of it. Secondary sinuses, if superficial, should also be laid open. Sometimes a sinus will be found to extend upward by the side of the rectum. If this be in the submucous tissue, the undermined mucous membrane should be divided. This can be conveniently done with blunt-pointed scissors, one blade being passed up the sinus, and the other up the bowel. But this division must not be carried out of sight and reach of the operator for fear of hæmorrhage. If the sinus extend farther than this, and division be considered requisite, it may be effected by a galvanic or elastic loop.

If the sinus be in the peri-rectal connective tissue, division is unnecessary, as it will close when a free outlet for the discharge has been made. It may, with advantage, be injected with tincture of iodine, diluted with an equal quantity of water. The wound should be carefully packed with cotton-wool, and any oozing of blood can be controlled by the pressure of a pad of lint and a T-bandage. The bowels must be kept inactive for some days. About the fifth or sixth day some castor-oil, or similar laxative, may be administered, and afterwards a daily, easy action of the bowels insured. After each motion the wound should be thoroughly syringed. The wound may be daily filled with cotton-wool, and the compound tincture of benzoin, or nitrate of silver, five grains to the ounce, may be applied with advantage; but many surgeons are content to have the wound syringed out only with a stimulating lotion, thus obviating a daily painful proceeding. The patient must maintain the recumbent position until healing is completed, which usually occurs in about six weeks. Sometimes, however, the process is very tedious, and change of air and sea-bathing may prove of service. As a rule, however, a surgeon will act more wisely in insisting on complete rest, and keeping the patient under his personal supervision until the cure is completed.

Phthisical patients are very subject to anal fistulæ. If the pulmonary disease be far advanced, any operation would be useless. Otherwise the tubercular diathesis need not be any bar to the operation, as the patient's general health will probably be benefited if the fistula can be healed. But in such cases healing is especially tedious, and, in order to prevent disappointment, the patient should be warned of this beforehand.

The Hippocratic treatment of anal fistula by ligature has been recently revived by some surgeons. It has the great advantage of not interfering with the patient's ordinary avocation, but is only applicable in recent and uncomplicated cases. It is unsuitable if there be secondary sinuses, and as these are usually only discoverable when the primary fistula has been divided, the number of cases in which the ligature can be employed with advantage is very limited. The ligature may be inelastic or elastic. If the former, the ligature—whether of silk, whipcord, or silkworm gut—should be passed through the fistula by means of an eyed probe, and then, the probe having been withdrawn, the ligature should be tied so as to constrict the tissues, but not so tightly as to excite inflammation. It should then be drawn tighter daily, or every second day, until it shall have cut through the tissues, and the resulting wound should be dressed with cotton-wool in the ordinary manner. This was essentially the method employed by Hippocrates, who used a five-fold ply of undressed flax corded with horsehair, as a ligature. If the flax became corroded before its task was accomplished, more flax could be attached to the horsehair, and so drawn through. In order to avoid the repeated tightening of the ligature, an india-rubber band of suitable strength may be passed through the fistula, and the tissues at once adequately constricted, the ends of the ligature being either knotted or clamped.

The ligature, whether elastic or inelastic, takes from six to fourteen days to cut through the tissues, and sometimes causes severe inflammation, so that even in the simplest cases, if the patient can afford the requisite time, division by the knife is the preferable procedure.

Sometimes, but very rarely, anal fistulæ heal spontaneously. In cases of incomplete external fistulæ, examination of the mucous membrane of the bowel with a speculum will sometimes disclose a punctured cicatrix, corresponding to what had been the internal opening of a complete fistula. If there be a free outlet for the discharge, the rest of the channel may also close. This result may be aided by dilatation of the perineal opening with laminaria. But the process is tedious, and the benefit often illusory, since the fistula, even if it should close, is prone to recur. This mode of treatment should therefore only be adopted when, from the general condition of the patient, operative treatment is impossible.

Incomplete Anal Fistulæ.—In the external variety, a director should be thrust through the thinnest part of the undermined mucous membrane of the bowel, and the case treated as one of complete fistula. In the internal variety, a curved director should be passed into the sinus, which should then be laid open down to the perineum, and the resulting wound dressed in the ordinary manner.

Jeremiah McCarthy.

FLAT-FOOT.—*Definition.*—A falling down or giving way of the normal arch of the foot, which may be so slight as to be scarcely noticeable except from the discomfort it causes, or so severe that the inner malleolus touches the ground, with the outer border of the sole raised.

Causes.—Flat-foot is directly due to weakness of the leg-muscles, which pass in front of and behind the inner malleolus into the sole of the foot. Infants on commencing to walk are normally flat-footed and without any arch to the feet; after running about for a few months, a perfect arch is formed when the muscles of the leg have become sufficiently developed. Anything that weakens the patient generally tends to produce flat-foot, as too rapid growth, the occurrence of acute fevers, &c. Infantile paralysis of the leg produces flat-foot as soon as the patient begins to walk. The writer finds that two out of every three patients with lateral curvature of the spine have flat-foot of varying degrees of severity. Flat-foot is intimately associated with knock-knee, and the one may induce the other, or both may commence simultaneously. Injury or chronic disease of one leg, throwing extra work on the sound limb, will frequently induce flat-foot in the latter.

Pathology.—When flat-foot is due to general muscular weakness, there is at first a simple relaxation of the tarsus with slight displacement downwards of the scaphoid, which can be easily replaced when the feet are taken off the ground, or by standing with the heels raised. In time, the scaphoid becomes more and more thrust inwards and downwards till it is partially dislocated; this sub-luxation is accompanied by more or less displacement of the inner cuneiform bone and the astragalus. The articular surfaces of the scaphoid and adjacent bones become so altered that complete replacement is no longer possible. When the tarsus has become so distorted, the muscles of the leg and sole may in time recover their strength, but are unable to restore the depressed arch of the foot. While the muscles are weak and unable to support the plantar arch, undue pressure and tension are thrown upon the ligaments and tendons in the foot, which become irritated and painful. In some cases, so much irritation is produced that the articulations between the scaphoid and the inner cuneiform in front and the astragalus behind become inflamed, and ankylosis results.

Symptoms.—As already mentioned, flat-foot is a very general term and includes everything from a slight relaxation of the plantar arch to extreme cases where the internal malleolus touches the ground, as in some cases of infantile paralysis. In severe cases there may be scarcely any pain or discomfort, except that of wearing down the inside of the boot in an unusual way, which may be accompanied by a sort of waddling gait in walking; while a patient with but very slight flat-foot may suffer constant severe aching or acute pain over the whole inner aspect of the plantar arch, extending upwards over the dorsum of the foot and frequently even up the legs to the knee or beyond.

Treatment.—With a view to treatment cases of flat-feet may be divided into three groups:—

(1) Cases in which it is possible to restore the foot completely to the normal shape by passive manipulation, without any decided force being employed.

(2) Cases in which the tarsal bones have become more or less fixed in their displacement by fibrous ankylosis, shortened ligaments or osseous deformity, and which require operative interference under anæsthetics.

(3) Intermediate cases, in which *partial* restoration of the normal plantar arch is possible by passive manipulation. Groups (1) and (3) require (*a*) the restoration and maintenance of the previously depressed plantar arch, and (*b*) the strengthening and approximation of the parts that support the normal instep.

(*a*) Boots really shaped to the form of the feet should be worn, made from an outline drawn round the foot while the patient is standing with the toes, especially the great one, well spread out inside the stocking, so that the inner margin of the foot is nearly straight and parallel with that of its fellow. It is essential that the outer portion of the sole should also touch the ground through the boot, which in all severe cases should be made without a heel, and with the 'waist' stiff, since the chief motion of the foot during walking takes place at the metatarso-phalangeal articulations, and not in the arch of the foot. A wedge-shaped pad, with the straight side forming the base, and corresponding in size to the normal hollow of the plantar arch, is fixed inside the boot. The best materials for the pad are superimposed layers of felt or horsehair, firmly packed in a suitably shaped leather case. Steel springs or solid india-rubber pads cause too much discomfort, if they be fairly brought against the depressed plantar arch. In no case is the pad to extend right across the 'waist' of the boot, as this at once interferes with the normal transverse plantar arch. The boot being made without heel, the pad has the same effect in it as on the ground. The boot must be laced, as the pad, to be efficient, should be well braced up against the plantar arch. In more severe cases, if the foot still treads over, it is necessary to have, in addition to these properly made boots, an outside leg-iron to below the knee, fixed to the boot, with a triangular leather band on the inside, attached to the sole and fastened round the iron. Where possible, these irons should be avoided, as they interfere so much with the use of the feet.

(*b*) To strengthen and approximate the parts that support the plantar arch, systematic exercise is most useful. Walking forwards and backwards bare-footed on the toes, with the heels moderately raised, for 100 steps, several times daily, is easily carried out and is very efficient; so also is walking on the outside edge of the feet, with the soles directed inwards and slightly forwards.

Anything causing cold feet must be removed, such as tight garters worn above or below the knee, which should be replaced by suspenders attached to a band round the pelvis. The circulation of the lower extremities, if languid, must be promoted by extra clothing if necessary, and by warm baths, followed by rapid cold sponging and good friction in drying. If the leg muscles are very weak, massage for half an hour twice daily should be employed. *See* MASSAGE.

If any knock-knee is present, this should be corrected at the same time.

In group (2), where the displacement of the plantar arch is immovable, forcible breaking down of the adhesions under anæsthetics should be done, and the patient kept in bed for a few days, when the treatment advised for groups (1) and (3) should be applied. Severer operative measures, such as the removal of a wedge-shaped piece of bone from the tarsal arch under antiseptic precautions, do not appear justifiable to the writer, who has not yet seen a case which offered any reasonable probability of this treatment being of permanent benefit to the mutilated patient. *See* CLUB-FOOT (Talipes Valgus).

BERNARD ROTH.

FLOATING TUMOURS. *See* ABDOMINAL TUMOURS, Diagnosis of.

FOMENTATIONS.—A combination of heat and moisture, in the form of a fomentation, is one of the most soothing and at the same time one of the most efficient therapeutic agents which can be applied to inflamed parts. The tensive pain of inflamed parts is relieved, possibly by relaxing tissues and so reducing tension, whilst the severity and extent of the inflammation may be diminished and the formation of pus prevented. The beneficial effects of fomentations on cutaneous and subcutaneous inflammations are striking and apparent, but deeper parts, the internal organs, are not beyond the reach of their influence; they cause relaxation of spasm, as in renal and hepatic colic, and they influence inflammations, as in acute cystitis, orchitis, &c. When suppuration has taken place, fomentations are sometimes recommended, on the ground that they will hasten the advance of pus towards the surface; this is undoubtedly correct, but it is equally certain that the knife, rather than a fomentation, is to be recommended, for by its means the pus may be evacuated at once and further destruction of tissue arrested, whilst the natural process, accelerated as it is by fomentations, involves the breaking down of all the tissues lying between the abscess and the surface. But when the abscess has been opened, and the tension of accumulated matter removed, the inflammation will tend to subside, and then fomentations are very useful, as they hasten the resolution of the inflammatory products.

When the skin of the inflamed part is not broken, soft flannel, wrung out of boiling water, or spongiopiline, similarly treated, makes good fomentations, but if the inflamed area be also wounded, antiseptic fomentations are preferable; two or three folds of boracic lint or a thick piece of salicylic wool, steeped in boiling water, and thoroughly wrung out, make admirable antiseptic fomentations. Whatever material be used it must be covered over with a piece of oil-silk or macintosh cloth of larger size than itself, in order to retain the moisture, and this, again, must be covered with a thick layer of cotton wool, in order to retain the heat; the whole application should be fixed in position by some form of bandage, which is easily applied and easily removed without causing the patient much disturbance. For the limbs the many-tailed bandage is the best. The external covering of cotton wool is most important, for without it the heat of the fomentation would be quickly lost, and even with it the loss is so rapid that it is desirable that fomentations should be changed every hour or two hours.

Fomentations should be wrung as dry as possible, for they can then be borne by the skin at a higher temperature than when the moisture has not been so thoroughly expelled.

To make a fomentation the cloth should be placed in a 'wringer,' consisting of a piece of stout towelling with a rod at each end, and boiling water poured over it into a basin; the fomentation should then be squeezed dry by twisting the rods in opposite directions; in the absence of the wringer an ordinary towel answers very well. The fomentation should be carried to the patient in the wringer and at once applied.

Fomentations are often used as vehicles for applying other therapeutic agents; thus, if a strong counter-irritant effect is desired, 20 or 30 minims of turpentine may be sprinkled on the fomentation; if an anodyne effect be required, one or two drachms of the tincture of opium or belladonna may be sprinkled on the fomentation, or equal parts of the extract of belladonna and glycerine may be first smeared over the inflamed part, and then the fomentation be applied. In some cases the effect of heat without the relaxation of tissue produced by an ordinary fomentation is desired, and then bran, chamomile heads, or sand heated in a pan over the fire and poured into suitable bags, may be applied over the affected parts. These applications are especially effective in relaxing muscular spasm and relieving its attendant pain.

BILTON POLLARD.

FOOT, Amputations in the.—Much of what has been already said in reference to the methods of amputating the fingers, applies equally to the corresponding operations on the toes. Partial amputations, excepting that of the great toe, are seldom, if ever, performed, the stumps resulting being short, useless, and inconvenient, from their tendency to upward projection. The distal phalanx of the great toe is, however, occasionally removed; but it is important to preserve as much as possible of the great toe, so much of the weight of the body being thrown upon it. Previously to the operation, it is desirable to render the part anæmic by the application of an Esmarch bandage. An assistant then draws aside the adjacent toes by means of a loop of bandage over them; and the surgeon, forcibly flexing the distal on the proximal phalanx, makes a transverse incision with a narrow-bladed straight bistoury or scalpel, exposing the joint. Continuing the forcible flexion, the knife is inserted behind the distal phalanx and a plantar flap is cut from behind forwards. Amputation in the continuity of the first phalanx can be done either by the circular, or by antero-posterior or lateral flaps made by transfixion. The latter plan is the one the writer prefers, as there is less risk of a plantar cicatrix. The bone should be divided with a pair of cutting pliers. For the metatarso-phalangeal amputations, the oval method, as already described, is the one most suitable. In the amputation of the great toe, it must be borne in mind that owing to the size of the head of the metatarsal bone, care should be taken to make ample provision for covering it, and that this can best be done by bringing the oval incision well on to the first phalanx.

In cases where the removal of the metatarsal bone of the great toe is indicated, it is well, in order to preserve the insertion of the peroneus longus, if possible, not to disarticulate, but to divide with cutting-pliers or saw, which should be done obliquely, to prevent any angular projection of the edge of the bone. In operations on the toes the surgeon must remember that the joints are more deeply situated than the corresponding articulations in the fingers. The following points should be observed in complete or partial amputation of the toes:—(1) All methods of amputation should be rejected from which a plantar cicatrix may result; (2) the most suitable method in the amputation of all the phalanges is by two curved incisions—a dorsal and a plantar —by which means the largest available amount of integument can be obtained to cover the heads of the metatarsal bones; (3) in the metatarso-phalangeal amputations the oval method should be adopted, and the dorsal incision should be commenced well behind the point where the bone is to be either divided with a cutting-pliers or disarticulated; (4) in this particular group of amputations, disarticulation should be, if possible, avoided, and this is especially important in dealing with the great toe; (5) in dividing the metatarsal bones, let those of the great and little toe be cut obliquely, to avoid any sharp projection of the edge of the bone against the skin; and (6) let the comparatively greater depth of the joints of the toes than of those of the fingers be borne in mind.

Amputations through the Tarso-metatarsal Articulation.—The method now preferred is that of Lisfranc, which is an improvement on the somewhat complicated procedure of Mr. Hey, of Leeds. Lisfranc, having determined the line of the incision, which is taken from a point immediately behind the spur of the fifth metatarsal bone, on the outside, to a point behind the projection at the base of the metatarsal bone of the great toe, on the inside, makes a curved incision with a strong scalpel, which should reach to a point three-quarters of an inch below the centre of the line corresponding to the articulation, its convexity directed forwards from one point to the other. The incision should not be brought lower down than the point indicated, otherwise the cicatrix would be drawn too far back on the face of the stump, owing to the retraction of the plantar flap. In this incision the integument alone is divided. A second incision made a little behind the first, and on a level with the retracted skin, divides the extensor tendons and dorsal ligaments over the articulations of the 5th, 4th, and 3rd metatarsal bones, assuming the operation to be on the right foot. In continuing this incision to divide the interosseous ligaments, since the 2nd metatarsal is wedged in between the internal and external cuneiform bones, its position must be borne in mind in disarticulating. The joint between the 1st metatarsal and internal cuneiform bone is then opened, thus completing the disarticulation. The interosseous ligaments being freely divided, two lateral incisions are made from behind forwards, their length corresponding as nearly as possible to half the circumference of the foot at the tarso-metatarsal articulation. Grasping the condemned portion of the foot, the surgeon forcibly extends it and cuts the plantar flap from behind forward, keeping as close as possible to the bone. In forming the flap, its edges should be sloped in order to facilitate subsequent adaptation. The vessels requiring ligature are the dorsalis pedis and the plantar arteries. Hæmorrhage having been arrested, the edges of the wound are brought together by means of numerous points of interrupted suture.

Of the foregoing operation an account of a modification practised by the late Prof. R. Wm. Smith was published by the writer some time ago, in which he claimed as an advantage the preservation of the two anterior points of support—namely, the ball of the great toe, and the base of the 5th metatarsal bone. The importance of this is obvious. The operation is performed by making an oblique incision across the four lesser metatarsal bones, commencing about three-quarters of an inch in front of the base of the 5th metatarsal bone, and in a direction towards the metatarso-phalangeal articulation of the great toe. The incision should be made down to the bones and another incision should then be made at the centre of the first one, but at right angles to it, upwards and inwards, for about an inch or an inch and a quarter. The tissues at each side of the second incision should then be dissected off the bones, and these, thus freely exposed, should be obliquely divided close to their proximal articulations with a small saw or fine forceps. The flap should be taken altogether from the sole of the foot.

In the case of a crushed foot, it would be best to dissect up such dorsal and plantar flaps as might be possible, and then to apply a saw at any convenient spot, either in the metatarsus or tarsus.

Chopart's Medio-tarsal Amputation. This operation is a disarticulation through the tarsus between the os calcis and cuboid on the one side, and the astragalus and scaphoid on the other. As guides to the articulation there are two landmarks—one, on the inside, a point immediately behind the tubercle of the scaphoid; and the other, on the outside, a point midway between the spur at the base of the 5th metatarsal bone and the external malleolus. These two points determined, the surgeon grasps and extends the foot, and making a lunated incision between them, carries it arched forwards three quarters of an inch below the articulation. The flap then is dissected back and the articulation opened. Two lateral incisions are next made, as in Lisfranc's operation, to guide the operator in forming the plantar flap, which is made by cutting from behind forwards and keeping quite close to the bones. It has been recommended to make the plantar flap first, which is done by cutting from without inwards, the flap extending to the heads of the metatarsal bones. Care should be taken to avoid a mistake sometimes made of confounding the articulation between the scaphoid and cuneiform bones with the astragalo-scaphoid joint. This is done by remembering that the articulation lies behind the tubercle of the scaphoid, and not in front of it. Professor von Langenbeck recommends preliminary tenotomy of the tendo Achillis, to prevent the retraction of the plantar flap bringing the cicatrix on the front of the stump; but if the plantar flap be made sufficiently long, as already described, there is no necessity for such a procedure. The arteries requiring ligature are the plantar vessels and the dorsalis pedis, as in Lisfranc's operation, and the same method is adopted of bringing the edges of the wound together by points of interrupted suture.

Other defects in Chopart's amputation have, it is stated, been observed; these are a tendency to eversion or valgus of the remains of the foot, to displacement of the heel upwards and backwards, liability to ulceration on the cicatrix, from its being drawn downwards on the face of the stump, and to the subsequent supervention of caries in the os calcis. These alleged defects of Chopart's operation the writer has not observed; though he can easily understand the probability of their occurrence if the plantar flap be not made of sufficient length. It is necessary to make allowance for the retraction of the plantar tissues which takes place to a greater or less extent after Chopart's operation.

William Stokes.

FOOT, Dislocation of the. *See* Ankle, Dislocations at the.

FOOT, Dislocations of Bones of the. Cuboid, Dislocation of.—From the strong plantar ligaments connected with this bone, and the powerful tendon grooving it, one might infer that dislocation would be a most exceptional injury. There is no recorded case of uncomplicated dislocation; but there are two specimens in the Musée Dupuytren of partial displacement downwards associated with dislocation of the astragalus.

Cuneiform Bones.—Dislocation of these bones is rare, and, when it does occur, is determined by their shape in an upward direction. The *internal cuneiform* is the most frequently dislocated in an upward and inward direction, a position due in part, no doubt, to the action of the tibialis anticus muscle. Astley Cooper records two cases, and Smith another, which were left unreduced. Nélaton, for a compound dislocation, removed the bone. All these patients recovered with useful feet. To effect reduction the great toe should be drawn forcibly outwards, and the bone then pressed into its place; but any difficulty in reduction or any tendency to reluxation should suggest to the surgeon the propriety of dividing the tibialis anticus tendon.

Scaphoid Bone of the Foot.—A simple dislocation *upwards* has been recorded by Walker. A bricklayer, jumping from one wall to another, alighted on his toes and fell forward. The scaphoid formed a prominence on the dorsum, and a depression existed where its tuberosity should, normally, have projected. By drawing the foot forcibly downwards and pressing with his thumbs, the surgeon reduced the bone with a click. Bryant mentions a similar case from Birkett's practice, which was also reduced; and Smith an unreduced case which he saw some years after the accident. Piédagnel has recorded a compound dislocation *downwards*, complicated with fracture, for which amputation of the foot was performed.

Scaphoid and Astragalus. — These bones are occasionally dislocated together upwards and outwards. Burnett has related a case caused by a gentleman, when hunting, taking a fence with his foot pressed strongly against the outer edge of the stirrup. The dislocation was compound, and the bones were reduced by pressure. B. Anger has recorded a somewhat similar case. For dislocations of the astragalus *see* Astragalus, Dislocations of the.

Smith's Dislocation of the Foot.—R. W. Smith first described a dislocation of all the metatarsal bones, together with the internal cuneiform, and explained the adhesion of this tarsal bone to its metatarsal as due to the tibialis anticus and peroneus longus tendons being partly attached on either side of the articulation. The foot was shortened an inch; a ridge due to the displaced bones occupied the dorsum of the foot; the plantar surface of the foot was convex transversely and from before backwards, and looked inwards. Dissection showed the bones to be displaced upwards and backwards. Smith describes two unreduced cases of long standing; Dupuytren one which he reduced; and Bryant two cases, one of which was displaced inwards.

The writer proposes to term this peculiar displacement *Robert Smith's dislocation*, in remembrance of that distinguished Dublin surgeon.

Tarso-Metatarsal Dislocations.—The metatarsal bones may be dislocated together *upwards*, *downwards*, *inwards*, or *outwards*. They may be also dislocated singly, or in groups of two, three, or four; and, rarely, some may be dislocated in one direction, whilst others are dislocated in another

These injuries are caused by falls from a height on the toes (the way in which Smith's dislocation is usually caused), or more frequently by crushing accidents. Many have been for a time overlooked, on account of swelling. The shortening of the foot in front of the ankle and loss of the arch, prominence of the bones, and deflection of the toes, are the principal signs of dislocation of all the bones. In single dislocation the projecting bone is generally evident, and the toe is shortened. In many cases extension has failed to produce reduction, but useful feet have remained. Hitzig has analysed 29 cases; 13 were of single bones, and 16 of the entire metatarsus; 11 of the latter were displaced upwards.

Toes, Dislocations of.—Metatarso-phalangeal dislocations are the most frequent; but inter-phalangeal displacements occasionally take place. Malgaigne records three instances of dislocation of all the toes—two upwards, and one compound and outwards. The latter necessitated excision of the end of the first metatarsal bone before reduction could be effected. The same author has collected 19 cases of dislocation of the great toe, all of which occurred in males. It may take place upwards and backwards, upwards and inwards, or upwards and outwards. The first form is the most common, and is often as difficult to reduce as dislocation of the thumb, for similar reasons. The treatment is the same as for metacarpo-phalangeal dislocation of the thumb.

Subastragaloid Dislocation of the Foot.—A displacement which leaves the astragalus in its normal relation to the tibia and fibula, but carries away all the other bones of the foot in a definite direction, is a not infrequent accident. Much confusion has existed concerning these subastragaloid dislocations, which, till somewhat recently, were altogether overlooked and confounded with dislocations proper of the astragalus, luxations of the os calcis, and midtarsal dislocations. The head of the astragalus is not firmly bound to the scaphoid, there being no inferior ligament uniting them, and but a comparatively weak superior one; hence, except for the support of other bones, this joint offers little resistance to dislocation. With the os calcis the astragalus is united by a strong interosseous ligament; but above there is a kind of mortise-like locking between it and the tibia and fibula, which, it is not difficult to understand, might often bear the strain of injury better than its ligamentous connections with the calcaneum. In this accident the foot separates from the astragalus at the calcaneo-astragaloid and astragalo-scaphoid joints.

Subastragaloid dislocation of the foot may take place in four directions—*inwards*, *outwards*, *backwards*, and *forwards*, of which the first-named is the most common. These dislocations are very rarely complete—that is to say, the articulating facets of the os calcis are not entirely removed from contact with those of the astragalus.

Subastragaloid dislocations may be distinguished from enucleations of the astragalus by the head of the bone being felt at its normal distance from the tibia and malleoli; by the fact that none of its upper articular surface is to be detected projecting beneath the skin; and by the existence of movements of flexion and extension at the ankle-joint. From dislocations of the calcaneum they are to be diagnosed by observing that the whole foot is turned in the same direction as that bone, and that the head of the astragalus has escaped from its socket. Dislocations of the ankle-joint are unaccompanied by the prominence caused by the displaced head of the astragalus, and the movements of the joint are lost.

R. Clement Lucas.

FOOT, Fractures of Bones of the.—Astragalus.—Though not very rarely dislocated, the astragalus is but seldom fractured; some clear examples, however, of this injury have been recorded. Doubtless fracture is sometimes present, though it is masked by the enclosed situation of the bone, or by injury of the surrounding parts. It is usually caused by falls from a height on the feet, and may involve any part of the bone—its neck, general mass, or posterior portion. It is often accompanied by dislocation. The writer lately met with a case in which, together with a partial dislocation, so that the bone was rotated on its antero-posterior axis in such a way that its inferior surface presented directly inwards, there existed a fracture of its internal border. This injury may be combined with fracture of the malleoli.

Symptoms.—Pain on pressure, or on any attempt to bear weight on the foot, the presence of crepitus on movement, combined with an absence of injury to other parts, and diminished height of the malleoli from the ground, would be the most marked signs of this injury. Sometimes the detached fragment has been found protruding under the skin. But when other tarsal bones are injured, and when swelling is considerable, an exact diagnosis cannot be made.

The only *treatment* generally required is to subdue inflammation by position, rest, and cold applications, and subsequently to maintain rest by a well-adjusted splint, or a light case of plaster of Paris. If any portion of the bone is protruded and cannot be replaced, it may be necessary to remove it. This operation should be performed with very careful antiseptic precautions. It is best, however, to postpone interference till the swelling and inflammation following the accident have subsided. As some stiffness is very likely to remain, a guarded prognosis should be given; and the foot should be placed at a right angle with the leg, so that the heel, when the patient is allowed to walk, may be easily brought to the ground.

Calcaneum.—This bone may be fractured either by direct violence, as the passage of a wheel over, or the fall of a heavy weight upon, the foot, by a fall on the feet, or by muscular action. The fracture may take any direction, or involve any part of the bone. When due to direct violence it is often extensively comminuted, and accompanied by great injury to the soft parts of the foot. Sometimes, though rarely, it is compound. When the result of muscular action, it involves the part of the bone lying behind the astragalus, and the fragment, variable in size, is drawn upwards—sometimes slightly, but sometimes to the extent of two, three, or even five inches, by the muscles of the calf. In fracture of other parts of the bone displacement is usually very slight, the fragments being held together by their connection with the surrounding fibrous structures of the foot. Cases in which both calcanea were fractured have been recorded.

The *symptoms* consist of pain, swelling, extravasation of blood, and crepitus, produced by grasping the heel and moving the anterior part of the foot upon it; by fixing the heel and flexing the anterior part of the foot; or by grasping the heel while the patient moves his toes. In cases of extensive comminution there is marked increase in the width of the bone below the malleoli, and flattening of the arch of the foot. When the bone has been severely crushed, especially if the fracture has involved the sustentaculum tali, so that the tendons have been displaced, the strength and movements of the foot are considerably diminished, and there may be a troublesome tendency to valgus. Generally, however, in fracture uncomplicated with much displacement, satisfactory recovery takes place, although repair is very tedious.

Treatment, when displacement is slight, consists in reducing inflammation by position and cold applications, and the subsequent employment of a plaster of Paris or leather splint; and allowing the patient to be about on crutches for two months or more before any weight is thrown upon the foot. At a later period much may be done by careful passive movements, after any adhesions that may be present have been broken down. When the fragment is displaced by the muscles of the calf, the leg must be flexed upon the thigh and the foot extended on the leg, as in rupture of the tendo-Achillis, and retained in that position either by a loop passing from the heel of the slipper and fastened above the knee, or by the apparatus recommended in rupture of the Achilles tendon.

Tarsus and Metatarsus.—Fractures of the remaining parts of the tarsus, and of the metatarsus call for no detailed notice. They are always the result of direct violence, and are frequently compound, and attended with considerable laceration of the soft parts. When the fracture is simple, all that is required after adjustment has been effected is a splint to control the fragments and keep them at rest. For this purpose plaster of Paris is often useful. When the soft structures are lacerated, or when the bones are comminuted, care should be taken to remove parts as sparingly as possible. Yet it must be remembered that when the foot has been crushed the soft parts are often more widely injured than is at first sight apparent, and extensive sloughing of the flaps will sometimes take place.

Howard Marsh.

FOOT and ANKLE, Diagnosis of Injuries and Diseases of.—In diagnosing an injury about the foot and ankle the surgeon must remember—(I) certain bony landmarks; (II) what are the common injuries; (III) the chief points which will help in diagnosis.

I. Bony Landmarks.—*Malleoli.*—The outer descends lower than the inner, and locks the joint in more completely, a point which makes opening the joint in Syme's amputation more easy on the inner side. The tip of the outer is about half an inch below and behind that of the inner malleolus. Their posterior borders are in the same plane, owing to the greater antero-posterior diameter of the internal.

Foot.—Inner side.—(1) Internal tuberosity of os calcis. (2) Tip of internal malleolus. (3) Sustentaculum tali, one full inch below internal malleolus. (4) Tubercle of scaphoid, one full inch below internal malleolus and a little lower down, the gap between (3) and (4) being filled by the calcaneo-scaphoid ligament. (5) Tuberosity of the internal cuneiform bone. (6) Base of first metatarsal bone. (7) Head of metatarsal bone and sesamoid bones.

Outer side.—(1) Outer tuberosity of os calcis. (2) External malleolus. (3) Nearly one inch below the malleolus, and a little in front of it the peroneal tubercle, with the short tendon above and the long below. (4) Base of fifth metatarsal bone.

II. INJURIES COMMON IN THIS REGION. These may, for practical purposes, be divided into two groups.

A. *Those without fracture or dislocation.*—(1) Sprains. (2) Rupture of tendo Achillis. (3) Slipping of tendons.

1. *Sprains.*—Sprains of the ankle are fully described under that heading; it remains only to point out the chief points which distinguish them from fracture or dislocation. Amongst these are the absence of crepitus or bony deformity, the comparatively slight injury, such as a slip or twist on uneven ground, the fact that the patient has very likely been able to use the foot between the time of the accident and the visit of the medical man, the correspondence of measurements between bony points in the two limbs.

2. *Rupture of the tendo Achillis.*—It may be diagnosed by the comparatively trivial violence, as the mere strain of walking, dancing, &c., the feeling of a snap or as if a blow had been struck on the part, the depression between the ruptured ends, increased by action of the muscles, &c. Much more rarely the rupture of a tendon near the ankle takes place in the case of the peronei or tibialis posticus.

3. *Slipping of Tendons.*—This usually takes place with the peronei, which most frequently of all tendons in the body get out of their grooves. The condition may be diagnosed by the history of a twist or slip, followed immediately by pain, swelling, and ecchymosis along the sheath, and the feeling of the tendon as it slips backwards and forwards over the posterior edge of the external malleolus.

B. *Injuries accompanied with Fracture or Dislocation.*—Those most frequently met with are—(1) Fracture of the lower ends of the fibula and tibia, with partial dislocation of the foot. (2) Dislocation of the astragalus. (3) Subastragaloid dislocation. (4) Dislocation at the ankle, which may take place laterally or antero-posteriorly, the dislocation outwards being most common, and all of these dislocations being very liable to be accompanied by fracture of one or other of the bones of the leg. (5) Fracture of astragalus. (6) Fracture of os calcis. (7) Injury to epiphyses, e.g. that of the tibia.

III. The following are the chief points to which paying attention will aid the practitioner in making out the nature of an injury about the ankle, accompanied with fracture or dislocation :—

1. *The kind and severity of the violence*—thus, a sudden exertion, as in lawn-tennis, dancing, running, &c., may produce rupture of the tendo Achillis, slipping of the peronei, or sprain of the ankle. A slip on uneven ground, down a bank, &c., may produce a sprain or one of the slighter forms of fracture of the malleoli, with displacement of the foot outwards or inwards, far more frequently the former. More violent twists, a direct blow upon the ankle, coming down with the foot sideways after leaping, the foot being caught and fixed while the body is free to move, jumping from a carriage in motion, and similar accidents, are much more likely to cause the severer forms of Pott's fracture, and dislocation of the astragalus, or subastragaloid dislocation of the foot.

2. *Comparison of the two ankles and feet.* If a depression is found one or two inches above the external malleolus, with prominence of the malleolus on the inner side, the practitioner will know that he is dealing with Pott's fracture. If, in addition to the above, there is widening between the malleoli, there is probably a split running through the lower extremity of the tibia into its inferior articular surface, as well as a fracture of the fibula. If the malleoli seem to have settled down on to the dorsum, and under the skin of this region is a projection lying obliquely inwards or outwards, resembling the anterior and rounded, or superior and trochlear surface of the astragalus, this bone has probably been dislocated. If the malleoli have not sunk down on to the dorsum, if some movement of the ankle-joint remain, and just in front of the tibia the head of the astragalus can be felt rounded and prominent, one malleolus projecting while the other is buried in a deep fossa, the foot being inverted or everted, and no crepitus obtainable, a subastragaloid dislocation of the foot laterally has probably taken place.

3. *Crepitus.*—This is often difficult of detection in fractures of this region, owing to the rapidity with which the natural fixity of the parts is increased by swelling,

the great pain, and by the fact that occasionally, as in Pott's fracture, reduction may have taken place. The following may aid in detecting crepitus:—Pressure with two fingers on either side of the suspected fracture, e.g. a malleolus; rotation of the foot from side to side; keeping one finger over the suspected site of fracture, and making pressure at a distance so as to 'spring' the bone of the fibula at the spot where this is broken.

In the absence of other symptoms of fracture—e.g. displacement—where, after severe injury, there is much pain, inability to use the foot, and deep-seated crepitus, fracture of the astragalus or os calcis may be present. Where in an apparent fracture of the end of the tibia, the crepitus is modified, when the patient is about sixteen or seventeen, and when the lower end of the upper fragment is smooth and rounded instead of sharp and rough or angular, the injury is separation of the lower epiphysis of the tibia.

4. *Measurements.*— These are of less value here than in fractures of the long bones, owing to the injury not being so localised, and the amount of swelling which so often obscures the bony landmarks. Finding, in examining a suspected case, injury to the ankle or foot, the practitioner will remember that the majority of patients will make no allowance for the difficulty and obscurity which often accompany the examination of these cases, or for the tedious and troublesome sequelæ which sometimes follow on most careful treatment, and, remembering this, he will do well to fortify himself with the advice and opinion of a friend or neighbour.

The most common forms of disease which present themselves for diagnosis in the foot are the various forms of synovitis and caries. Synovitis in its acutest form will be often met with in a sprain of the ankle. Forms much more insidious, and tending gradually, if untreated, to serious disorganisation, are met with in the ankle, the calcaneo-astragaloid, and the medio-tarsal joints. Stiffness and tenderness, preceded by some injury or over-use (both, perhaps, of little apparent moment), are followed by increasing swelling and actual pain. In the case of the ankle-joint the swelling will show itself chiefly in front and around the malleoli. In the case of the astragalo-calcanean joint the swelling is much less distinct, owing to the depth and surroundings of the joint. No certain diagnosis can be made without watching the case, allowing for its insidiousness, its crippling nature, and the exclusion of any evidence of disease of the ankle-joint. In synovitis of the medio-tarsal joints, which should always, if possible, be recognised early, owing to the extent of the synovial membrane and the number of bones with which it is in contact, it will be found, on comparing the two feet, that the natural instep is lost, being gradually replaced by a swelling which gradually becomes more and more clubbed.

Where pulpy disease and caries have followed on synovitis, their presence will be known by the preceding history, the longer duration, the formation of abscesses here and there, owing to the implication of the skin and soft parts, leading to sinuses, with their characteristic bluish, undermined edges and prominent granulations. The chief seats of caries are the os calcis, the ankle-joint, and astragalus (for these may practically be taken together, the latter being only occasionally by itself the site of disease), the medio-tarsal joint, occasionally only the cuboid, and, more often, the metatarsal bones, these being, especially in 'strumous' children, liable to be the sites of multiple caries. From the devious burrowing of pus, sinuses over a bone do not necessarily mean caries of that bone, but must be taken with other points, such as the site of the chief thickening; whether behind and below the malleoli and obliterating the natural hollows there, as in caries of the os calcis, or in front of the malleoli and even a little up the leg over the ankle-joint, combined with impaired movement of the joint, when that is involved, and so in other cases. Sinuses on the plantar aspect of the foot almost always point to that form of caries which is associated with, or secondary to, Perforating Ulcer.

W. H. A. Jacobson.

FOREARM, Amputation of the.—Amputation of the forearm may be performed at either its lower, middle, or upper third. Owing to early prejudice against the operation in the lower third on the part of some eminent French operators—notably Larrey—on account of the large number of tendons, the middle and upper thirds were the situations preferred. The opinion generally accepted now, however, is that unless there be some special contra-indication, the lower third is the most desirable situation. The particular operation to be selected depends largely on the situation in which it is to be performed. The circular or rectangular methods are best in the lower third; in the middle of the forearm, the antero-posterior flap method or the rectangular amputation; and in the upper third, Syme's modified circular, or the antero-posterior flap method. When practicable, amputations of the forearm, whatever method be adopted, should, as maintained by Skey, be performed below the supinator brevis and pronator radii teres, with a view to the preservation of pronation and supination of the limb.

The *circular* operation may be performed as follows:—Pressure on the brachial artery should be made either by digital pressure, by an Esmarch bandage, or a Petit's or Signoroni's tourniquet. The elastic Esmarch bandage is, in the writer's opinion, to be preferred. Supposing the right forearm to be the one to be operated on, the surgeon, standing on that side of the patient, grasps the forearm with his left hand and retracts the skin, the portion of the limb to be removed being held steadily and somewhat elevated by an assistant. A circular incision is then made with a medium-sized amputation knife down to the fascia, and the skin dissected back for the distance of an inch or an inch and a half. The second stage of the operation consists in the division of the muscular tissues at the upper angle of the wound down to the bones. There the interosseous membrane and periosteum round each of the bones are carefully divided, and the bones are then simultaneously sawn across. The radial, ulnar, and interosseous arteries should then be secured, and the wound dressed. This method may also be employed in the upper third of the forearm, but is not so applicable to the centre or middle third of the forearm, where the flap operation is, as a rule, performed.

In this situation the antero-posterior *flap* method, for the reasons already stated, is the operation usually indicated. It may be carried out by long anterior and short posterior flaps, or by antero-posterior flaps of equal length. They may be made either by transfixion, or, if the arm be large and muscular, by cutting from without. Short musculo-cutaneous flaps, with oblique division of the deeper structures, are recommended by Sédillot (Alanson's operation somewhat modified). The simplest and best method, when the middle third of the forearm is the situation to be operated on, is that by antero-posterior flaps made by transfixion. The limb should be held in the prone position by an assistant. The operator then, grasping the dorsal tissues with his left hand, draws them up, determining accurately at the same time the edges of the ulna and radius. With a medium-sized catlin the dorsal tissues are transfixed, care being taken not to fall into the error, occasionally made by unskilful operators, of getting *between* the bones. A flap two or three inches in length is then made, and in doing so the operator should avoid having an irregular, jagged edge to it. This he can best do by avoiding too short and sawing an action of the knife in the division of the tissues. The flap having been made, it is held back by an assistant, and the catlin is then reintroduced in front of the bones, and a flap somewhat longer than the posterior one is made, ending somewhat differently, for the tissues should not be divided so obliquely as in the posterior flap, but cut more abruptly or squarely. The interosseous structures should then be divided, the periosteum carefully incised at the points where the bones are to be sawn, and the latter then simultaneously divided. The radial, ulnar, and interosseous vessels will require ligature, the first two of which will be found in the anterior flap, the radial being most superficial.

Teale's rectangular flap method is, in cases where the tissues are abundant, applicable to amputations of the lower and middle thirds of the forearm. In the upper third, where the bones occupy a more central position, and the muscles are thick, lateral flaps have also been recommended. The writer, however, fails to recognise any advantage to be obtained by substituting this latter method for either the modified circular or the antero-posterior flap operations.

In performing Teale's rectangular amputation, the radial vessels should be in the short flap. 'The operator,' Mr. Teale observes, 'in forming the long flap, makes the two longitudinal incisions merely through the integuments, but the transverse one is carried directly down to the bones. In dissecting the long flap from below upwards, the tissues of which it is composed must be separated close to the periosteum and interosseous membrane. The short flap is made by a transverse incision through all the structures down to the bones, care being taken to separate the parts upwards close to the periosteum and membrane. The prone position is recommended, to allow the dorsal flap to be superior when the patient is recumbent, and thus fall over the ends of the bones.'

In reference to the statistics of amputations of the forearm when performed on account of serious injuries, it is interesting to note a fact recorded by Dr. Otis, and mentioned by Agnew in reference to the superiority of primary over intermediary and secondary amputations, the mortality of primary being 9·6 per cent., intermediary 23·5 per cent., and secondary 15·7 per cent. The special points to be borne in mind in amputation of the forearm, are:—

I. Division, when possible, of the bones below the insertion of the pronator radii teres and supinator brevis.

II. Selection in the lower third of the circular or rectangular operations, and in the middle and upper thirds of the antero-posterior flap method.

III. In the latter group of amputations the division of the bones at least half an inch above the angles of incision of the soft parts, in order to prevent projection of them at the sides of the wound.

William Stokes.

FOREARM, Diagnosis of Injuries and Diseases of the. *See* Arm and Forearm.

FOREIGN BODIES IN THE AIR-PASSAGES.—Foreign matter of the most diverse kind, gaseous, liquid, or solid, not infrequently enters the air-passages, and gives rise to symptoms, varying in severity and urgency according to the nature, size, shape, and position of the offending substance.

Irritating vapours or minute solid particles suspended in the air, as they touch the upper part of the larynx generally excite such a violent fit of coughing that they are swept away at once, and, beyond the immediate distress and discomfort, give rise to no further consequences. Only exceptionally, when, as in the case of steam from a tea-kettle, they are drawn well in by a sudden inspiration, and inflict serious injury on the mucous membrane, does inflammation follow and affect the larynx, or the trachea and bronchi, or even the lungs themselves. So also with liquids; only, from the peculiar circumstances under which they enter, the consequences are more lasting and more serious. It is rare for them to penetrate further than the larynx, from which they are ejected at once, unless it has undergone some change which has either impaired its sensibility or rendered it less capable of rapid and co-ordinate action. For example, after wounds involving the floor of the mouth or the air-passages (such as cut-throat), and also after tracheotomy, the larynx sometimes loses its delicate sensitiveness, probably from swelling and œdema of the mucous membrane, and does not close with sufficient rapidity to prevent liquid portions of food passing down the trachea into the lungs. Pneumonia set up by this is the cause of the fatal issue in many cases of tracheotomy which have survived both the primary mischief and the immediate effects of the operation. The same thing may happen as a consequence of diphtheritic paralysis, or when a patient is insensible, either from anæsthetics or from alcohol. During operations about the mouth, blood and fluids from the stomach vomited up may be drawn down the trachea, and, according to the amount, either cause an immediately fatal asphyxia or broncho-pneumonia some days later.

Solid substances may enter under similar conditions; sets of false teeth (which ought always to be removed prior to the administration of an anæsthetic), a tooth dropped from the forceps immediately after extraction in the haste to grasp a second, wedges to keep the mouth open, improperly secured, are all recorded as having dropped into the larynx. The same thing has been known to occur during sleep, or in the vomiting following anæsthesia. A case of death after the administration of ether was found to be due to the skin of a ripe plum, rolled up; it had been vomited during the stage of recovery, drawn into the larynx, and was firmly wedged into the right bronchus, so that its upper extremity fell over and occluded the orifice of the left. In the vast majority of instances, however, this very serious accident arises from a careless habit of holding things in the mouth or between the teeth, especially in the case of children. Something or other, such as a laugh or a blow on the back, causes a sudden inspiration, and the substance, whatever it may be, is drawn down through the widely open glottis and lodged in the air-passages before it is known that the hold on it is lost. Blow-tubes carrying a dart, pea-shooters, and other hollow instruments, act in the same way. A child, in trying to fill its chest with air previously to a vigorous expiratory effort, often inspires with all its force through the tube, and draws the projectile into the larynx.

It is rare for solid bodies to enter in any other fashion, but exceptional cases are on record in which they have penetrated through wounds, or, more often, through openings produced by ulceration, especially of a malignant character, where the trachea or the left bronchus lies in contact with the wall of the œsophagus.

Cases of epithelioma of the œsophagus are not infrequently brought to an unexpectedly rapid termination by an attack of pneumonia set up in this way.

The symptoms that follow the entry of a foreign body are either immediate and due to obstruction, whether this is caused by the substance itself or the spasm it excites; or else remote and secondary, set up by the inflammation that follows; and they depend mainly on two conditions—the position of the body, as determined by its size, weight, and shape, and the changes which it undergoes itself or induces in the tissues with which it is in contact. For convenience of description the air-passages may be divided off roughly into three portions—that lying above the rima glottidis, including the upper aperture and the ventricles of the larynx; the lower part of the larynx and the trachea, including its bifurcation; and, lastly, the bronchi of the second order and the lungs. Of course this division is artificial, and it does not by any means follow that when a foreign body is fixed in one part the symptoms will be confined to that part; but there is sufficient difference both in the consequences and in the treatment to justify its adoption.

When lodged in the *larynx*, the symptoms caused by a foreign body are most severe and very characteristic. From the spasm, distress, and violent cough produced when anything touches the interior of the larynx, it is easy to infer the course of events when either a large rounded mass blocks the opening by its size, or a smaller but sharp and angular one is impacted in the mucous membrane and sets up spasmodic contraction. The patient starts up wildly, gasping for breath, and clutching at his collar; the face is livid, rapidly becoming cyanosed; the veins in the neck and in the forehead stand out like cords; he may be quite unable to speak, or, more often, if the orifice is not quite closed, utters the most distressing inarticulate cries, attempting at the same time to put his finger down his throat; violent coughing, often leading to vomiting, is rarely absent; the body becomes more and more convulsed, a cold sweat breaks out all over, commencing on the face, and within a minute he may fall down unconscious, fæces and urine escaping without control.

The symptoms, however, are not always so urgent as this; after some time—it may be a few minutes or it may be some hours—they gradually diminish in intensity, leaving the patient in a state of complete exhaustion. But they are liable to return with all their former severity at any moment, and this tendency to recurrence with intervals of almost complete repose is one of the most important points in the question of diagnosis. Their degree of severity depends mainly on the size and shape of the body and its exact position; if it is smooth and rounded, of some material that does not swell up or undergo other change, and lodged in one of the ventricles, they may be exceedingly slight, or be postponed for an almost indefinite period, although the patient is never free from the danger of asphyxia, due to dislodgment and impaction elsewhere, or from the risk of inflammation and ulceration. Pain, or a sensation of tickling in the region of the larynx, often felt in the ear, and a sense of anxiety or of impending suffocation, are nearly always present; so are frequent and violent fits of coughing, characteristic from the sudden way in which they come on, their sharp, spasmodic character, and uncontrollable violence; a change of posture is often sufficient to induce them. At first they are unattended by expectoration, but afterwards, when inflammation has set in, this may be copious, thick, and stained with blood. The respiration, especially in children, is often distinctly croupy, so as sometimes to render the diagnosis difficult; but it is to be noted, conversely to what happens in croup, that expiration is generally more difficult than inspiration. The voice may be quite lost, or may at first be hardly altered in its tone, according to the position of the foreign body; but nearly always it becomes changed and hoarse after the first few hours, from swelling and œdema of the mucous membrane.

If the foreign body is allowed to remain, the symptoms that arise vary greatly in different cases. When it is sharp and pointed, or of such nature as to be a continual source of irritation to the structures among which it is lying, inflammation sets in rapidly; and although confined at first to the larynx and the immediate neighbourhood of the offending substance, soon spreads thence to adjacent parts, and finally to the trachea and lungs. Ulceration of the mucous membrane, involving the cartilages at last, and causing necrosis and destruction of the articulations; spasm and œdema of the glottis, with constant danger to life at any moment; emphysema of the lungs; congestion, followed by bronchitis and broncho-pneumonia; rupture of blood-vessels from the violence of the cough may ensue. Great impairment of the general health, ending in fatal exhaustion, from the combined effect of inflammation, continued anxiety, and want of rest, will follow inevitably sooner or later, sometimes commencing within a few days, or, in exceptional instances, not sufficiently severe to attract serious attention till years have elapsed and the exciting cause has almost been forgotten.

In those cases in which the foreign body slips between the vocal cords and enters the *trachea*, but is too large to be admitted into the bronchi of the second order, the immediate symptoms are, as a rule, of less intensity, the secondary ones more severe. They seem to depend mainly on whether it is fixed in the mucous membrane of the trachea or remains free in the interior, so that it can move up and down, and depend consequently more upon the shape and weight of the substance than anything else. A smooth, round, heavy body, such as a coin, falls down to the bifurcation, and, owing to the position of the septum, is generally directed to the right side, where it either becomes impacted in the bronchus or remains free, and with every cough shifts its position. This makes the diagnosis more easy, for in addition to the distress, dyspnœa, and pain that are always present after the entry of a foreign body, every time it comes in contact with the larynx or moves in the trachea it excites such violent paroxysms of coughing, often preceded by a deep whooping inspiration, as are seldom met with under other conditions, especially as aphonia under these circumstances is not a common symptom. Sometimes the patient is himself conscious that the body shifts its position; or it may be heard, and even has been felt from the outside, moving about in the trachea. It occasionally happens that during one of these attacks the foreign substance escapes through the orifice of the glottis with instant relief; but it must not be forgotten that it may be caught and held in the same situation, and give rise to a spasm that will prove rapidly fatal.

If the shape is more irregular, particularly if it is pointed at one end like a bearded ear of corn or a puff-dart, both of which are more than usually dangerous from the way in which they lie with their points uppermost so that each cough drives them further and further in, it generally becomes fixed, and soon excites inflammation, attended by copious expectoration and ulceration. The rapidity with which this sets in depends on the irritating nature of the body and on the changes it undergoes. Some organic substances, particularly when they are retained in a bronchus in contact with the mucous membrane all round, and exposed to a moist and even temperature, swell up to double their former size, and, in the case of seeds, have even been known to show signs of germination. Others remain unchanged themselves and become less irritating, though their size is increased from the deposition of layers of mucus on their surface. When fixed in this way the pain is felt most acutely over the actual spot, although a sensation of soreness behind the sternal notch is rarely absent. Aphonia is not met with, at any rate at first, and the fits of coughing, being due rather to the irritation and inflammation, are less violent and spasmodic, but more continuous, than when the foreign body is always shifting its position and coming in contact with the larynx.

The same train of symptoms is apparent when the foreign body is small enough to pass beyond the bifurcation of the trachea and enter the *bronchi* or the substance of the lung, only now those caused by the obstruction are less marked in proportion to the smaller area shut off, and those due to the consecutive inflammation become more prominent. Important evidence in addition may be obtained from an examination of the chest. If one of the bronchi, and it is usually the right one, is partially obstructed, that side of the chest moves less in inspiration, the percussion note is unaltered at first, and the respiratory murmur is diminished; while occasionally an unusual whistling sound may be heard, owing to the passage of the air past the obstruction, and nearly always coarse râles, due to the greatly increased secretion thrown out by the irritated mucous membrane. On the other hand, should the whole of one lung or of one lobe be shut off, vocal fremitus and the normal vesicular murmur are completely absent over the corresponding area, and the respiration over the rest is puerile and exaggerated. The percussion note varies; at first it is normal, or may even be hyper-resonant for a time, but in a few hours, as the lung becomes congested and the air absorbed, this diminishes to such an extent that it may be almost dull.

The later symptoms, consequent on lodgment in the lungs, depend on the intensity and progress of the inflammation that follows. It may be slight, and even postponed for years; more often it is rapid and acute, broncho-pneumonia setting in with great severity and running on to the formation of abscesses, with destruction of the lung, and even gangrene or fatal hæmoptysis, this depending in all probability on the ease with which the intruding substance undergoes septic changes. Pulmonary tubercle, hyperæmia and swelling of the bronchial glands, ending in caseation and suppuration, and occasionally empyema, with even the escape of the foreign body through the walls of the thorax, have also been described as resulting from this injury, though they are much more rare.

Numerous instances are on record in which the accident has been overlooked and the symptoms assigned to some other cause, and nearly as many in which the opposite mistake has been made. Nor is this surprising when we take into consideration the fact that there is no single symptom peculiar to it alone, and that the history, which is of the utmost importance, is often altogether wanting, because the patient was either insensible at the time or too young to be able to give an account of himself. Foreign bodies in the pharynx, by pressing on the back of the larynx, or by the spasmodic contraction they set up, may cause immediate death with all the symptoms of obstruction to the larynx; but this is not of so much importance, as the same treatment would apply to either if it could only be carried out in time. When the symptoms are less urgent the diagnosis is easily made by making the patient swallow, or, if necessary, by examination with the finger or an œsophageal probang.

Inflammatory affections of the air-passages set up by other causes are much more hard to diagnose. Croup, especially in children, and laryngitis setting in suddenly, may be very difficult to distinguish in the absence of any history. Most reliance is to be placed on the sudden character of the onset, and the absence, at the commencement, of feverish symptoms as judged by the state of the pulse and the skin. It is very rare for either croup or laryngitis to commence with such rapidity or attain such severity in the first few moments, and the remissions that occur in the course of these diseases are not nearly so complete. Moreover, in spasmodic croup, the chief difficulty is during inspiration—the reverse of what obtains when a foreign body is lodged anywhere in the respiratory tract.

Hysteria, reflex irritation arising from disorders of the alimentary canal, especially in children, spasm of the glottis consequent on ulceration of the larynx or trachea, œdema due to the same cause, even such affections as aneurism of the aorta, pressing on the laryngeal nerves, and whooping cough, may occasionally present such symptoms as to make the diagnosis doubtful at first, particularly if the history is misleading—if, for example, the patient was known to be holding something in his mouth when the attack first commenced and the substance cannot be accounted for. Sometimes, too, the feeling of irritation left after the foreign body has been removed is so distinct that the patient firmly believes it to be still there; and it must not be forgotten in connection with this that on several occasions more than one foreign body has been known to enter the larynx at the same time, and that it is quite possible for some of the substances which find their way in to break into separate pieces during a violent attack of coughing.

Treatment.—Unless the case is so urgent that the larynx must be opened on the spot, it is most important to obtain as accurate an account as possible, not only of the previous condition of the patient, and of the fact that he was holding in his mouth or playing with some substance which cannot be found, but also of the nature, size, and shape of that substance, so that some idea may be formed of the situation in which it will lodge and of the changes it will undergo. Then, if the symptoms permit, a thorough and careful examination of the mouth, epiglottis, and upper part of the larynx, must be made with the finger and the laryngoscope, an anæsthetic being administered if it is required. If nothing can be ascertained by this, if the acute symptoms have passed off, and only recur at intervals with less intensity; and particularly if there is no aphonia or pain in the region of the larynx or ear, it is probable that the substance has passed through the rima glottidis and is lodged in the trachea or bronchi, where its presence may be ascertained by careful inspection, auscultation, and percussion. Very severe symptoms at the first, subsiding without extrusion, point to the substance having passed the larynx and entered into the trachea; their repeated recurrences suggest its still being present in the larynx, or loose in the trachea and coughed up against it.

'It may be definitely and decidedly asserted that life is in peril so long as a foreign body of any appreciable size is retained in the respiratory tract. At the same time it is very uncertain at what period danger may become imminent, and in what way it may arise' (Durham). Suffocation, laryngitis, hæmorrhage from ulceration, inflammation and œdema, pneumonia, pleurisy, phthisis, or gangrene, may make their appearance at any time so long as the foreign body is retained; and even after it has been expelled the morbid process originated by it may still go on to a fatal issue. The first thing, if time permit, is to make as sure as circumstances allow that a foreign body is really there; and then, unless the symptoms are very urgent, to endeavour to ascertain in what part it may be lodged. Sometimes laryngotomy must be performed without an instant's delay if it is to be of any service. The operation is easy, the crico-thyroid membrane superficial, the extra risk to the patient quite trivial, and the danger of hæmorrhage slight; while the relief is perfect in proportion to the severity of the symptoms, and valuable time is gained for more deliberate action.

When the case is not so urgent, when, as is usually the case, the patient is seen after the first violent paroxysm has passed off, during the deceptive calm that follows, an attempt must be made to ascertain the exact position of the substance; but under no circumstances should the patient be left without assistance. Many cases, especially in childhood, have suddenly proved fatal from œdema, spasm or impaction, owing to the deceptive calm that so often follows the first outbreak.

By means of the laryngoscope and laryngeal forceps of various shapes a large number of foreign bodies of all kinds have been extracted from the larynx. Even in children this method succeeds sometimes, while with adults the results are very encouraging, pins, bones, rings and other substances having been removed even after long periods of impaction, without external wound or any after-trouble. The extreme sensibility of the mucous membrane in many patients, rendering even examination difficult, and any operation impossible, may in general be overcome by the prolonged application of ice or the inhalation of chloroform vapour. Small subcutaneous injections of morphia over the superior laryngeal nerve in the region of the greater cornu of the hyoid bone are sometimes very successful as a temporary measure; and provided the time can be afforded, large doses of bromide of potassium for several days help materially; but the most useful application of all for this purpose is a 20 per cent. solution of hydrochlorate of cocaine. If the fauces and the upper aperture of the larynx are painted with this three times at five minutes' interval, the mucous membrane becomes quite insensitive without the least danger or inconvenience, and remains so for a quarter of an hour, so that operations may easily be performed while the patient is free from pain, quite quiet, sensible, and able to assist.

Should the laryngeal forceps fail, owing to the situation of the foreign body preventing firm hold being obtained or from any other cause, the choice of the surgeon lies between laryngotomy and exploration of the interior of the larynx from below with a probe or gum-elastic catheter (using the end covered with an ivory cap and taking care that it is well secured), or thyrotomy—i.e. a vertical section in the middle line between the two alæ of the thyroid cartilage, so that when they are separated the whole cavity is exposed to view. The latter is the better of the two unless laryngotomy has already been performed to relieve symptoms of obstruction. The whole interior of the larynx, including the ventricles, can be thoroughly explored by this operation, and if care be taken to keep the section exactly in the middle line, and to unite the perichondrium or the fibrous layer covering the cartilages accurately by catgut sutures, union takes place readily and the voice rarely suffers.

Supposing it has been ascertained that the foreign body is not in the larynx, and the symptoms point to its being in the trachea or bronchi, tracheotomy, or if the neck is very short laryngo-tracheotomy, should be performed without more delay than the time to administer an anæsthetic. Emetics, sternutatories, inversion, and other so-called remedies only waste time and distress the patient. It is true they have all of them occasionally been successful, but the same thing might be said with equal truth of the plan of leaving the patient alone. The only possible exception is in the case of small, round, and heavy bodies loose in the trachea without urgent symptoms; but even then inversion should never be attempted without all preparations being made for instant tracheotomy, and it is as well to avoid having to perform this operation against time.

It often happens that the foreign body is ejected either through the glottis or the tracheal opening, immediately after this has been made, a large volume of air being taken in, the spasm completely relaxed, and violent coughing excited. When this does not occur, and very often it is some time before the intruding substance is dislodged, the patient is almost safe from the danger of asphyxia, and valuable time has been gained for other measures. No canula should be inserted unless extraction fails; retractors, easily made with a piece of bent wire, should be fixed in the tracheal opening and fastened round the neck with an elastic band, so as to maintain a certain amount of tension on the orifice. The patient may then be turned over on to his abdomen with the edges of the wound held as wide apart as they may be, gradually inverted and sharply struck across the back opposite the spines of the scapulæ. Or the body may be secured on a narrow table in the supine position, which has the advantage of presenting the widest part of the glottis to the foreign body when it comes in contact with it, quickly inverted, and compressed with a broad circular bandage, so as to secure vigorous expiration in that position.

If this procedure fails and the foreign substance is too firmly fixed to move, the trachea, and bronchi, as far as they can, must be very gently explored with probes, hooked at the end, tracheal forceps (either Gross's, which are made of German silver so that they can be bent to any shape, or Mackenzie's, or Durham's, which are so contrived as to open only at the extremities), and even with the finger. All these attempts bring on violent expiratory efforts, no matter how gently they may be performed, and sometimes in this way, sometimes by being actually hooked up, large firmly-wedged bodies have been extracted, even from the right bronchus. A great deal depends on a knowledge of the nature of the substance: tubular bodies, such as a broken-off tracheotomy canula, from their allowing one blade of the forceps to enter the interior and grasp the margin, or both blades to pass inside and raise it by the pressure they bring to bear when opened, are particularly easy of extraction. The worst of all are such things as puff-darts, which lie with the point uppermost and fixed in the mucous membrane, so that every effort of expiration only serves to drive it further in; if this can be felt to have perforated the trachea it should be cut down upon and removed with pliers.

It by no means always follows that the operation of tracheotomy is successful at once: there are many instances in which a canula has been inserted and worn for some time, and then quite unexpectedly, perhaps from changes it undergoes itself, or from ulceration round it, the foreign body has suddenly become detached and been expelled.

The main object in the after-treatment is to check any tendency to inflammation. The patient must be confined to his room, and even to bed, for the first few days; the air must be kept of even temperature, and sufficiently warm and moist, by means of steam; there is no need to retain the canula after extraction unless œdema of the larynx is feared; the wound need not be closed by sutures, but covered over with a layer of moistened gauze to prevent the entry of cold or dusty air, and allowed to granulate; the edges will generally be found in apposition and the tracheal opening almost closed, from the elasticity of the cartilages, in twenty-four hours. The diet should be mild and unstimulating; morphia may be given (provided there is no severe bronchitis) to relieve the feeling of irritation, and expectorants if there is much secretion. If the foreign body has been impacted for any length of time there is nearly always some thickening and induration of the mucous membrane resulting from ulceration, but this usually subsides of itself after removal; the exuberant granulations that are sometimes found blocking up the passage must be removed by scissors or caustic.

In the later stages Gross considers an operation not only to be justifiable but highly proper so long as the respiratory passages are healthy or even comparatively healthy, no matter what length of time may have elapsed since the entrance of the extraneous substance. 'If, on the other hand, the respiratory apparatus is seriously diseased, the knife should be studiously withheld, certainly temporarily, if not altogether, on the ground that the artificial opening would be very likely to complicate the morbid action and thereby greatly enhance the patient's danger.'

C. Mansell Moullin.

FOREIGN BODIES IN THE BLADDER.—The urinary bladder is often the receptacle of a foreign body. The most common one is a broken surgical instrument. In the treatment of various urinary diseases catheters and bougies may break, and a portion be left in the bladder; or if such instruments be handled carelessly or left unsecured, they may slip into the urethra beyond reach, and ultimately into the bladder. Portions of stricture-cutting or dilating instruments, and instruments used in making caustic or other applications, have not infrequently broken off and passed into the bladder. The beak of the male blade of a lithotrite has broken off when crushing a stone; but the most serious foreign body of this kind is a lithotrite with its jaws so impacted in a stone, or bent, or jammed with calculous débris, that they cannot be approximated, making removal by the natural passages impossible. As a surgical curiosity, it may be mentioned that a small steel artery-clip was once found in the bladder of a lady long after she had made a good recovery from ovariotomy; the instrument doubtless had made its way from the peritoneal cavity by a process of ulceration. Next in order of frequency come foreign bodies introduced into the bladder by design, and left there accidentally by patients themselves. This may be done legitimately by persons anxious to relieve themselves of retention of urine or of stricture of the urethra, and who, lacking proper instruments, resort to stalks of grass or pieces of straw; but usually the motives which have prompted such self-manipulation have been most improper, or it has resulted from mere wantonness. Most extraordinary articles are sometimes introduced. The following have all been met with —hairpins, needles, pins, bodkins, straws, stalks of grass, penholders, pencils, tobacco-pipe stems, sealing-wax, glass rods, leathern thongs, string, nuts, marbles, wire, feathers, matches, pebbles, and beads.

Foreign bodies may enter by the ordinary accidents of military and civil life—as for example, bullets, fragments of shells, portions of clothing and arrow-heads, in war; pieces of wood and reeds, from falls upon such objects, and splinters of the pelvic bones from severe crushes. Then, as the result of disease (not necessarily malignant), an opening may exist between a portion of the intestine or rectum and the bladder, and fæcal matter find its way into that organ; fruit-stones and other bodies so conveyed, and too large to be expelled by the urethra, may give rise to trouble. Also, as the result of disease of the pelvic bones and of the hip-joint, portions of bone have found their way into the bladder. The bladder is sometimes the seat of a dermoid cyst, and hairs and sebaceous matter, with or without phosphatic coating, may be passed naturally or be discovered by exploration. Fœtal débris, bones, hair, teeth, have been known to find their way into the bladder. Finally, the various intestinal worms may enter the bladder by fistulous openings, and other parasites may be developed in the kidney and pass down the ureters. Hydatids occasionally find their way also into the bladder.

Consequences.—In rare cases life is immediately threatened. Death has been known to result from peritonitis, caused by perforation of the bladder by a sharp stalk of grass or other foreign body. As a rule, however, the first symptoms are those of cystitis, consisting of pain and frequency in passing water, with mucus and perhaps blood in the urine. If the offending body is not removed, it usually soon becomes encrusted with urinary salts; these are generally the phosphates, but more rarely the urates are deposited. The writer is not aware of an instance of the deposition of oxalates. The patient shortly becomes to all intents and purposes the subject of stone in the bladder, and there are specimens in many of our museums of urinary calculi having bullets, nuts, pieces of bone, &c., as nuclei.

Diagnosis.—The diagnosis is often sufficiently easy, and can only be difficult when the patient is reticent, or the foreign body is very soft, or when, as in the case of a catheter suddenly found to be without its end, the owner cannot be absolutely sure that it has not been lost since its last withdrawal from the bladder. The diagnosis can never be complete without careful sounding, and in rare cases even the digital examination of the bladder by dilatation of the urethra in the female, or by means of external urethrotomy in the male, may be absolutely necessary to clear up the case.

Treatment.—In cases of foreign bodies introduced by the urethra, unless the symptoms are very urgent, operative interference should not at once be resorted to, but every opportunity allowed for the natural expulsion of the body through the urethra. The patient should be kept at rest; if necessary an opiate may be cautiously administered; and he should be directed to hold his urine until a considerable quantity has accumulated in the bladder. He should then stand up, and with his legs slightly apart, make a free stream of urine. Such a proceeding will often cause the expulsion of a small foreign body, or it may thus become engaged in the urethra.

When, however, it is evident that the body cannot be naturally expelled, or if the case is urgent, an operation should be undertaken without delay.

Several instruments have been devised for the extraction of foreign bodies from the bladder, but as few of them are really practical, or are likely to be at hand when wanted, they need not be described here; there is one, however, for the removal of hairpins, which deserves mention, although the female urethra admits so readily and safely of dilatation that, with the finger and simple instruments, pins of all descriptions can usually be easily removed. It consists of a stout tube with a central rod ending in a hook; the hook seizes the pin, and the central rod is then screwed back into the stout tube, until the pin is bent and dragged into the tube and extracted. In addition to the usual lithotomy and lithotrity instruments (including evacuating tubes and aspirator), all of which may be found useful, the operator should be provided with a pair of nasal polypus forceps, a blunt hook on a long handle (an ordinary button-hook will do), a long urethral scoop and forceps, and if possible Sir Astley Cooper's forceps. This is an instrument like a curved metal sound; the curved end is split, and by pulling a trigger in the handle it separates laterally into two blades, which come together again directly the trigger is liberated, grasping any foreign body which may be present.

The most useful instrument for men and boys is a lithotrite; this instrument, however, requires care in its use, and special attention must be paid to three points. (1) It is not safe to crush glass in the bladder, but sealing-wax, clay-pipe stems, and other brittle materials may be safely attacked, crushed, and washed out through tubes, just as an ordinary calculus is removed by lithotrity. (2) In attempting to remove a soft or gummy body, such as the end of a vulcanised india-rubber catheter, the male blade must not be screwed home unless the body is known to be small or is felt to be seized in its long axis; for the jaws of the instrument may become jammed and the operator may be unable to remove it. (3) In seizing an oblong body it is almost sure at first to be seized transversely, and resistance will be encountered as the lithotrite and its load approach the prostatic urethra; if this is so, the lithotrite must be disengaged at once; generally after several seizures the body will be caught 'end on,' and extraction will be possible.

Women and Girls.—A careful attempt should be made to withdraw the body with a lithotrite, or with a pair of long urethral forceps, or with Cooper's forceps just described, or with a simple button-hook, if the foreign body be a hairpin. Should simple means fail, then under the influence of an anæsthetic the urethra should be dilated with a Weiss's dilator or a pair of polypus-forceps, and the surgeon's left *little* finger introduced. The nature and position of the foreign body will now be ascertained, and usually no difficulty will be met with in removing it, for the urethra admits safely of great distension, and forceps or hook may be passed along the finger and guided by it into position. If the foreign body after all should prove too large to be removed by the urethra, it may be extracted through an incision made into the vesico-vaginal septum, after which the edges of the wound should be carefully approximated and stitched up. The method of removal by incision of the urethra has few advocates. The supra-pubic method is not recommended in women. Should the foreign body owe its great size to deposits of calculous matter, lithrotrity may be practised, and the foreign nucleus afterwards extracted through the urethra; this remark is equally applicable to the male subject.

Men and Boys. — The lithotrite or Cooper's forceps should be used. If the foreign body be small, an attempt may be made to wash it out through an evacuating lithrotrity tube (No. 16 or 17 Eng.); a pebble, bead, or small pin may in this way be removed. Should the lithotrite part company with the foreign body in the deep urethra, the finger should at once be passed into the rectum and the body pressed upon from behind to prevent its return into the bladder. The finger in the rectum is often a useful adjunct in all manipulations now described, and the writer has succeeded with the finger alone in compelling the exit of a piece of catheter engaged in the neck of the bladder; and in another's practice, a shawl-pin, with a large round head, was ingeniously extracted with the finger in the rectum; the point of the pin was forced through the perineum, the pin's point was then brought well down to the coccyx, and the head thus pushed up the urethra to the meatus, whence the whole pin was withdrawn.

If all attempts at extraction by the urethra fail, the knife must be resorted to. If the patient is a boy, the ordinary lateral operation is, as a rule, to be preferred. If, however, the patient is an adult, the operation should not be more than an external urethrotomy (*la boutonnière*). This consists of a median perineal incision into the membranous urethra upon a grooved staff; a small gorget is next passed into the bladder and the staff withdrawn; the surgeon's forefinger is then passed through the dilated prostatic urethra into the bladder. After the surgeon has ascertained the exact position of the foreign body he may introduce a pair of small straight forceps and extract it. Should more space be required, the prostate may be divided downwards, and the operation converted into a median cystotomy.

G. Buckston Browne.

FOUR-TAILED BANDAGE. *See* Bandages.

FRACTURE-BOARDS may be made either as one piece, of sufficient size to extend over the whole bedstead; or in a number of separate pieces, long enough to reach across the bed, but only about a foot or a foot and a half wide. The latter have the advantage that they can be placed side by side over the whole bedstead, or only in the required situations. When the fracture-board is made in one piece, it is necessary to prepare the bed before the patient is placed on it; but with a number of separate pieces it is easy to slip them in or remove them without in any way disturbing the patient. The boards should be placed between the mattress and the bed.

Bilton Pollard.

FRACTURES are divided into *simple*, where the skin is entire, so that no air enters, and *compound*, where there is a wound through which air gains admission to the broken ends of the bone—a distinction of well-known importance, both as to the danger involved and the method by which repair is accomplished. They are further classed as *incomplete* (greenstick), when, as often happens in children, the bone is only partially broken; *impacted*, when one fragment is driven into the other and there locked; *oblique*, *transverse*, *longitudinal*, and *splintered*, terms which explain themselves; *multiple*, when the same bone is broken in two or more places, or when two or more bones are broken; and *complicated*, when the fracture is combined with other serious lesions—e.g. a dislocation, the laceration of a large artery or nerve, or the rupture of some internal organ, such as the liver or bladder. In early life the epiphyses may be separated, as will be described under the fractures of the various bones.

Causes.—The immediate causes of fracture are external violence and muscular action. External violence may be direct, as in gunshot injuries, and when a heavy weight falls on the limb; or indirect, when force is applied in the long axis of the bone, as when the clavicle is broken in falls on the hand. Or a sudden twist of a bone may produce fracture. Though the patella is the bone most often broken by muscular action, the same accident may occur to the clavicle, humerus, sternum, femur, and other bones. The various conditions which, by weakening the bones, act as predisposing causes of fracture, are chiefly mollities ossium, rickets, atrophy, whether senile or from disuse—as in old joint-affections—and inflammation, with extensive necrosis or caries, especially when syphilitic or strumous, and cancer.

Symptoms.—These are divided into the *circumstantial*—as when, after an injury to the head, blood and watery fluid continue to drain from the ear, or when emphysema and hæmoptysis occur after injury to the chest—and the *direct*, which are, altered outline or length of the limb, movement of one part of the bone on the other, and crepitus. Sometimes the patient feels, or even hears, the snap at the moment of fracture. The circumstantial, though they may be strongly suggestive, generally admit of some alternative construction, and are therefore inconclusive—e.g. the flow of blood and watery fluid may be from the ear itself; emphysema and hæmoptysis may depend on ruptured lung. As to the direct; although movement is easily felt when a superficial bone is broken in the middle of its shaft, it is not so when the bone—e.g. the body of the scapula—is deeply placed, or when a small block, difficult to grasp, is detached, as in fracture through the anatomical neck of the humerus. Both these difficulties are met with in fracture of the neck of the femur. Movement is often absent, as in impacted, or very slight, as in incomplete fractures. Sometimes it is impossible, as in fracture of the base of the skull, or wrong, as in fracture of the spine, even to attempt to produce it. Alteration of outline may result, either directly from the force which broke the bone, as when the skull is driven in; or from the weight of the limb, as when the shoulder drops inwards and forwards in fracture of the clavicle; or from contraction of the surrounding muscles, the strongest preponderating, and some acting on one fragment, some on the other, as when in fracture of the femur just below the trochanters the ilio-psoas and glutei flex and abduct the upper fragment, while the hamstrings draw the lower fragment upwards behind the other. Crepitus is often unmistakable, but it is very often absent. It is so in impacted and in incomplete or greenstick fractures. In some fractures, as those through the neck of the femur, it is felt only when, by drawing down the limb, the fragments are brought into contact. Even in fractures through the shafts of the long bones, it is sometimes impossible to bring the surfaces into such close contact as to produce crepitus.

Much care is required to distinguish between true crepitus and the grating often present in rheumatoid joints, and even the creaking in the sheaths of tendons. It is often difficult to be sure at exactly what point crepitus is produced. Mobility, and crepitus, as a faint and momentary click, are sometimes to be detected only in one particular movement of the bone. They are thus easily overlooked. It is therefore necessary, when the upper part of the bone has been fixed, not only to perform rotation, but to move the part below gently in every direction. In impacted fracture, in which there is neither mobility nor crepitus, the only reliable direct symptom is altered outline. The bone may be shortened, its axis may deviate, or some irregularity of surface may, as the fingers are carefully passed over it, be detected. In doubtful cases the question whether the injury is at some point where impacted fracture is common (e.g. the lower end of the radius, or neck of the femur), the cause of the accident, and the amount of pain, must all be taken into account. Care must be taken against concluding that there is no fracture, on the ground that the patient can move, or even bear weight upon, the limb. Not rarely in fractures of the clavicle the hand can be raised above the shoulder, or even placed on the head; and patients with fracture through the neck of the femur, the patella, the fibula, or in other parts of the lower extremity — especially when there is impaction—have been known to walk long distances on the limb.

From what has been said it will be seen that it is often impossible to secure positive proof that fracture has occurred. This is especially the case when the bone concerned is one of a series closely knit together, as in the carpus or metacarpus, or, even when, of two bones lying side by side, only one is broken—e.g. the ulna or fibula. And it may be as difficult to deny as to affirm that fracture is present. Yet it is highly inadvisable to endeavour, by forcible and prolonged examination, to obtain conclusive evidence. Our duty is, if doubt remains after all reliable means have been critically used, to adopt such precautions as may provide for safety, should fracture after all exist; to watch carefully the progress of the case; and to act on such further knowledge as may be obtained at any later stage. What reasonable patient would ask for more than this? In many cases an anæsthetic should be used. When the muscles by this means are relaxed, gentle manipulation will often elicit evidence which, without it, even forcible and painful movement of the limb would fail to disclose. An anæsthetic, however, it must always be remembered, is not given that rough manipulations may be practised—these are as dangerous when the patient is insensible as when he is conscious, and have often done irreparable harm.

Another point is that the limb is to be thoroughly exposed, and minutely compared with the opposite side. A complete examination should be made as soon after the accident as possible and before great swelling is present, so that accurate diagnosis has become out of the question. The diagnosis between fracture and dislocation may sometimes be difficult; nor must we forget that these two conditions may exist together. In fracture there is preternatural mobility; deformity is easily removed, but it returns when external support is withdrawn, and there is generally crepitus. In dislocation the limb is fixed in an abnormal position; there is no true crepitus; when its upper end is grasped and the shaft is rotated, it is felt to move in one piece, and the bone when once replaced, remains in position. Moreover, its various salient points can be felt in their normal relations to the rest of the bone, but the relation of the bone to its socket is changed. As rheumatoid joints often present grating, we must be careful not to conclude that what we feel is true crepitus without taking other symptoms into account.

Summoned to a fracture, the surgeon's first care must be to provide against further injury. The patient must be induced to remain as still as possible while preliminaries are arranged. The clothes covering the limb must be removed by cutting along the seams, and the limb must be securely supported by extempore inside and outside splints formed of pieces of board (thickly doubled newspapers will suffice for the upper extremity), a strong walking-stick, &c.; a shawl or thin pillow being used to protect the skin and distribute pressure. The patient must now be placed on a stretcher, or a door covered with spare clothes or straw, the surgeon himself taking charge of the limb, while he directs the bystanders how, acting steadily together, to lift the sufferer. The patient should be hand-carried if this is practicable, as the jarring of any conveyance may do serious injury. He must be lifted to bed with as little disturbance as possible, and placed on a narrow bedstead with a firm mattress, with a board beneath the latter to keep it flat. A feather bed is quite unsuitable. Some surgeons have advised that the fracture should not be 'set' before the third or fourth day. This, however, is an exploded view; adjustment should be effected with the least possible delay.

In the treatment of fractures three objects present themselves: (1) the replacement of the fragments; (2) their maintenance in position during repair; (3) the prevention or removal of complications. The difficulties which arise vary with the case. In the clavicle the displacement depends mainly on the weight of the limb, which falls inwards and forwards—little on spasmodic muscular action. Hence adjustment is easily effected by lifting the limb into its normal position. The difficulty here is to maintain reduction. In oblique fracture of the femur or tibia it is the powerful muscles of the limb that oppose reduction. In fractures of the surgical neck of the humerus the muscles inserted into its tuberosities rotate the upper fragment; and this is so deeply situated that we can sometimes neither learn its exact position nor turn it back into its place. Sometimes the mere irregularity of the fragments, or the presence of soft parts between them, hinders adjustment. To effect reduction the limb above must be fixed by an assistant, while extension is made below, as far as possible in the long axis of the upper fragment, the surgeon himself guiding the ends into place. In some instances of fracture of the tibia reduction cannot be effected till the tendo Achillis has been divided; but tenotomy, either here or in other fractures, is very seldom called for. Sometimes, in fractures of the femur, shortening cannot at the time be entirely removed; but it may gradually be subsequently overcome by weight-extension. Position sometimes assists—e.g. flexion of the leg on the thigh during the reduction of fractures of the tibia. An anæsthetic is often called for, not, of course, as before stated, that violence may be used, but because it obviates resistance which must otherwise be forcibly overcome.

If practicable the fragments should be at once exactly adjusted; but rather than make violent or over-long attempts, we must secure the best attainable position at the time, and improve this, so far as may be possible, by subsequent modification. If such swelling has occurred that neither a complete diagnosis nor satisfactory adjustment is possible at the time, the limb must be brought as far as may be into its normal position, such apparatus as can be used without restricting the circulation must be employed, ice-cold lotions must be applied, and the limb be placed in the best position for the subsidence of the swelling. The surgeon must wait for the earliest opportunity of completing reduction, whether by using more extension, the insertion here and there of pads, or even an entire re-setting, though this is generally both unnecessary and unadvisable. In using retention-apparatus we must provide efficient support, so as to guard against displacement due either to (*a*) the weight of the limb, (*b*) muscular action, (*c*) the movements of the patient; avoid all constriction, especially above the fracture; distribute pressure, and prevent its occurrence over prominences or tender areas; and place the limb in the most comfortable position, remembering that in a very few hours after a fracture is properly adjusted the patient ought generally to be free from pain in the limb, remembering also that considerable swelling is in prospect. This latter must be taken into account while the fracture is being put up, and very carefully watched subsequently. Tight bandaging not only causes pain, but may lead to gangrene or other serious consequences. It is dangerous to place strapping in a circular direction round the limb, and cover it with a bandage; should swelling occur below, we are apt, while loosening the bandage, to forget the strapping, and so fail to remove the constriction. Such an oversight has sometimes led to gangrene of the limb. For the first few hours the condition of the circulation in the fingers or toes should be carefully watched.

Complications.—(*a*) The soft parts may have been so extensively crushed that sloughing ensues, and the fracture becomes compound—no rare event in the case of the tibia and other superficial bones. Should this be threatened, the area involved should be protected by antiseptic dressings, and the subsequent treatment will be that for compound fracture. *See below.*

(*b*) Extravasation of blood may cause tense swelling and so lead to gangrene, especially if the bandages are tight. To avert such a result all circular constriction must be at once removed, the limb, supported in loosely adapted splints, must be raised (the same end may to some extent be attained by raising the foot of the bed), and if the surface be hot, evaporating lotions must be used. If however, the limb is cold, it should be wrapped in cotton wool. Bullæ should be pricked and emptied, but the cuticle must be carefully preserved.

(*c*) Rupture of the main artery, a grave accident, is happily rare. It is chiefly met with in fractures of the upper end of the humerus, the lower end of the femur, and the upper end of the tibia. The symptoms are: the rapid formation of a tense elastic swelling, in which a distinct thrill or even a faint diffused pulsation may often be felt; loss of sensation and coldness of the limb, and loss of pulsation in the vessels below. The choice of treatment is embarrassing. Three courses present themselves. To trust to compression or ligature of the artery higher in the limb; to endeavour to find and tie the two ends of the vessel; to perform amputation. This last step should not be taken till gangrene has absolutely set in, for the symptoms mentioned are not proof positive that the artery is torn, and recovery has sometimes occurred although they were all present. To search for the ends of the vessel is a proceeding surrounded with such difficulty, and involving such free dissection of the soft parts, that, although it may occasionally be justifiable, it cannot be recommended. The safest plan, generally, will be to try the effect of pressure on the artery above, applied if possible by the digital method, so that the return of venous blood is as little as possible interfered with. Ligature of the vessel above is, as a rule, unadvisable. Compression secures the same end, and can be remitted should swelling cease to increase, while ligature, by suddenly arresting the circulation, may precipitate gangrene. Where gangrene has supervened, amputation should as a rule be at once performed; though it may be right to postpone it when the patient is very old or very weak. The point selected must vary with the case. When the artery has been wounded by one of the fragments in a fracture produced without much violence, amputation may be performed just above; but when the fracture has been accompanied by extensive injury of the soft parts, amputation must be done at some distance higher in the limb, where the soft structures are uninjured. If this rule is not followed gangrene will probably reappear in the stump. The inference to be drawn from the appearance of bullæ varies in different cases. They result from extravasation around the fracture, and indicate extensive laceration. When the limb is cold and numb, bullæ are but another sign that gangrene is at hand. But when the surface is warm, and there is pulsation in the vessels below, bullæ may be regarded as evidence that serum is reaching the surface, and that tension is being relieved. *See* ARTERIES, Wounds of; FEMORAL ARTERY, Wound of the.

(*d*) Dislocation is sometimes produced by the same force which caused the fracture. This is a complication which may prove very difficult to manage, especially when one fragment is short and deeply placed, as in dislocation of the head of the humerus accompanying fracture high in the shaft. The possible existence of this condition must not be overlooked, nor can such a complication well escape notice during a careful examination, unless considerable swelling has already taken place. In any doubtful case examination must be repeated as soon as swelling has subsided. Reduction should be, when practicable, at once effected, but the attempt has often failed. It may sometimes be accomplished by enclosing the limb securely in splints, so that a firm hold is gained on the displaced end of the bone; and then, when the muscles are relaxed by an anæsthetic, employing the method by manipulation. *See* DISLOCATIONS. Failing reduction, the fracture must be adjusted in the best available position. When union has occurred —that is, in six or eight weeks—manipulation may be again tried; but at this period reduction generally cannot be effected, and the case must be treated as one of unreduced dislocation: adhesions must be broken down by careful manipulation, under an anæsthetic, when union of the fracture is firm, and passive movements must be employed with perseverance, to secure such motion as can be obtained. *See* HUMERUS, Fractures of the.

(*e*) When fracture extends into a joint, mobility may be permanently and considerably impaired by sharp synovitis, followed by adhesions; by the displacement of fragments which cannot be adjusted; or by the formation of callus, altering the shape of the articular ends. This is especially apt to be the case in comminuted Colles's fracture extending into the wrist-joint, and in fracture of the humerus just above the condyles, extending into the elbow-joint, particularly in children. In such cases the utmost care must be taken in the adjustment of the fracture, though the swelling which so quickly results may defeat this object. The surgeon in such instances should do himself the justice of at once explaining the state of the case to the patient.

(*f*) Œdema of the limb is often a troublesome complication. Following immediately on the fracture, it depends on copious serous effusion from bruising of the soft parts; it may depend entirely on tight bandaging; or, slowly ensuing some days after the accident, it arises from plugging of the veins in the neighbourhood of the fracture—a condition especially apt to occur in gouty or rheumatic subjects. In these cases fatal embolism may result from the detachment of thrombi and their passage into the lungs, or hemiplegia may occur from their transit into the arteries of the brain. Acute œdema, from phlebitis, must be treated by raising the limb and relieving circular pressure; the more chronic forms, often very obstinate, by frictions, shampooing, and by the application—when union of the fracture is firm—of Martin's elastic bandage, which is very efficient for the purpose. The treatment, however, must be gently conducted, or the phlebitis, always very prone to relapse, will be renewed.

Compound Fracture.—The gravity of compound, as compared with simple, fractures depends, to some extent, on the admission of air. But the danger accruing from this source has of late years largely diminished. Formerly, when sanitary conditions were neglected, the air which entered a wound was almost invariably charged with some septic material, so that a true inoculation of the tissues occurred. But now, when ventilation is amply provided, when all infectious cases are removed from the general wards, and when wounds are treated, whatever the details of dressing may be, on antiseptic principles, the mere admission of air is much less deleterious than it was twenty years ago. This is constantly demonstrated by the safe repair of that form of compound fracture which is artificially produced in the operation of osteotomy, in some instances of which, when a wedge of bone is removed, an opening larger than that of many compound fractures is made, and air is most freely admitted into every part of the wound. Compound fractures, however, are generally the result of much greater violence, and are attended with proportionately greater injury to the soft parts than is the case with simple fractures. Often the skin is widely stripped off, the muscular structures are reduced to a pulp, the main vessels or nerves are lacerated, and the bone is extensively comminuted. These injuries are the main sources, at the present day, of the dangers attending compound fracture.

Treatment.—Should either of the fragments—it is usually the upper—protrude through the skin, reduction must, if necessary, be assisted by enlargement of the wound at the point of greatest resistance. Should the fragment protrude far, and be completely bare of periosteum, or should reduction be otherwise impossible, a portion of the bone must be sawn off. The danger of this latter proceeding, as increasing the liability to pyæmia, osteomyelitis, or necrosis, has been exaggerated. Of course no part of a bone should be lightly sacrificed, but the removal of an end which is found to materially hinder reduction after the wound has been enlarged, is less objectionable than forcible and prolonged manipulation. In comminuted fracture, fragments which are completely loose should be removed; those which, though broken away from the rest of the bone are still covered in their whole length with periosteum, should be carefully replaced; while those which are partially bared must be dealt with according to circumstances. In young subjects they may be left, as also when on account of their depth from the surface they are difficult to reach. The condition of the soft parts may have some influence on our decision. When the surrounding injury is comparatively slight, so that nutrition will probably soon resume its ordinary course, they may remain; but when, especially in middle-aged or elderly persons, there is extensive crushing of the soft parts, with a prospect of long suppuration, in the course of which they would almost certainly perish, it is safer to extract any that are easily reached. Hæmorrhage must be arrested by ligature (with carbolised catgut), or by torsion. In order to do this, when bleeding is deeply seated, it is necessary freely to enlarge the wound (an Esmarch's bandage having been applied, or the artery being compressed above), to turn out all clots, and tie both ends of the vessel. *See below* on Amputation.

If large nerves are torn, their ends must be brought together by two or three fine catgut sutures passed through their sheath. The wound must then be thoroughly cleansed, and washed out in all its recesses with a 1 in 20 solution of carbolic acid in water, introduced by means of a gum-elastic catheter fitted to a syringe or to an irrigator. The surface of the limb must be well washed with the lotion; coagula, as far as possible, should be removed; a counter-opening for drainage, maintained by a tube or by a strip of guttapercha tissue soaked in the lotion, will often be advisable. The opening in the skin, if extensive or branched, may be partially closed; but an ample outlet for free drainage must be left. A strip of 'oil-silk protective,' or guttapercha tissue soaked in a 1 in 40 solution of carbolic acid, is placed over the wound itself, and the limb is widely enveloped in the neighbourhood of the fracture with gauze wrung out in the carbolic solution, and more superficially with eight or ten layers of antiseptic gauze, having a sheet of thin mackintosh between the outermost and the next layer. The quantity and the covering extent of the gauze must depend upon the probable amount of discharge. The dressings must be so applied as to admit of easy removal, without disturbing the fracture; and they must be changed often enough to prevent the discharge from escaping beyond them. They should be renewed, usually, on the second or third day, and then according to circumstances. If the wound has been long exposed to the air, it should not only be syringed out with carbolic lotion as directed, but iodoform powder should be dusted into the wound and between the fragments. A convenient dressing, when the wound is small, consists of oil-silk protective covered with folds of lint soaked in a saturated solution of boracic acid. *See* ANTISEPTIC SURGERY.

Mr. Sampson Gamgee's method of dry dressing is also excellent; or absorbent cotton-wool impregnated with iodoform, and covered with mackintosh, may be used; or the wound may be thoroughly washed out with a solution of one part of tincture of iodine to five hundred or a thousand parts of water. The condition of the limb, as the neighbourhood of the fracture is thus covered in, must be closely watched by observing the temperature, sensation, and circulation in the parts below. Great care must be used that the dressings are not applied tightly, but that some allowance is made for swelling, which will in all likelihood ensue. These dressings may be discontinued as soon as the wound has healed.

Amputation.—The treatment of wounds has undergone so complete a revolution during the last twenty years, that the rules for amputation in compound fracture have had to be recast. Conservative surgery has been carried to a point which it would formerly have seemed impossible to reach, and highly dangerous even to attempt. The change is shown in the greater rarity, not only of primary amputations, but of secondary also. The effort to save the limb is commonly justified by the result. Amputation, however, must still be performed in cases in which, without reckoning such complications as in former days threatened all large wounds—secondary hæmorrhage, cellulitis, prolonged suppuration, and the like—the fate of the limb is already sealed. As when all the soft parts are completely torn through, or when some considerable portion has been torn away in a machinery accident; when the whole thickness of the limb is completely crushed; when large areas of skin have been stripped off; when, with other formidable injuries, a large joint is torn open and its ligaments ruptured; when the main vessels and nerves of the limb are severed; when deep hæmorrhage is profuse, and the vessel cannot be reached without a wide, and therefore destructive, dissection of the limb, as when the popliteal, or the upper part of the posterior tibial artery, is lacerated. Conditions other than local must also have due weight—the patient's age, habits, and the presence or absence of visceral disease, especially of the kidneys. In the old, and in persons of unsound health, amputation is a formidable measure, and the choice between the risks of leaving the limb and of amputation are so evenly balanced that the case is one of great difficulty, and every point must be critically considered.

In young and healthy subjects, if the main artery is wounded, its two ends must be tied; if the main nerves are torn, their cut ends must be brought together by two or three carbolised catgut sutures, passed through their sheaths; if a joint is opened it must be thoroughly washed out with carbolic lotion (1 in 40) and provided with free drainage, and an attempt must be made to save the limb; for amputation, should it become necessary, can be performed later. But in deciding what our course should be, we must always bear in mind that our first charge is the safety of the patient's life; to save this we must not hesitate to sacrifice the limb. Should gangrene ensue, amputation must, unless contraindicated by the general condition of the patient, be immediately performed. In the later stages of the case, should secondary hæmorrhage of formidable amount occur (happily this is very rare), and be repeated in spite of compression of the trunk above; if suppuration is so copious that the patient is becoming dangerously weak; or if the fracture involved injuries which have disorganised the limb so that repair seems hopeless, secondary amputation must be resorted to.

In fractures which are attended with only moderate displacement and laceration of the soft parts, and are subsequently kept at rest, the callus is limited to the interval between the fragments, whether between their ends, or where they overlap. But when the soft parts have been widely injured, so that inflammation is considerable, or when the fragments cannot be kept at rest, as in fractured rib, so that inflammation is prolonged, callus is formed both in the medullary canal (interior callus), and in the parts around (ensheathing). These varieties are termed provisional. They exist during the process of repair, but are subsequently entirely removed; so that when normal repair is complete no callus remains but that which lies directly between the fragments. In compound fracture union takes place—after any sloughs that may have formed have been either extruded or absorbed—by the development of granulation-tissue between and around the fragments, and its subsequent ossification. The period occupied by repair varies widely with the degree of injury, and is extended by the tedious separation of sloughs and sequestra, and by the difficulties which attend healing where soft parts have been extensively destroyed. But it is generally twice or three times as long as that required in simple fractures. After union is complete, a process of modelling occurs, by which projections are rounded off, all superfluous callus removed, and the medullary canal re-formed, so that the bone is restored, in respect alike to its size and outline, density and strength, as far as possible to its original state. This is so perfectly effected that in many instances, even on section, no trace of the fracture remains. Union takes place very rapidly in children, and may be complete in ten to twenty days; in older persons it extends over—speaking approximately—six or eight weeks, and is more slowly effected the larger the bone concerned. The bones of the lower, perhaps because they are larger, unite somewhat more slowly than those of the upper extremity.

In fractures of the upper extremity splints may, as a general rule, be removed, and the patient be allowed gradually to resume the use of the limb, at the end of a month or five weeks. For the lower extremity, as it has to sustain the weight of the body, this time must be extended to seven or nine, or even twelve weeks, according to the age and the circumstances of the patient. But in each case the patient must be guided by the advice of his surgeon, given after a careful examination has been made, for sometimes union is found to have been unexpectedly delayed. Should any yielding be observed, he must be forthwith directed to abstain for a time from bearing weight on the limb. Great and unmanageable deformity will otherwise supervene; witness the distortion of the leg which sometimes gradually ensues after Pott's fracture. Various, some of them fanciful, causes of delayed union have been assigned, Those calling for mention here are (*a*) local, (*b*) general. The first include defective apposition of the fragments, want of rest, the intervention of some of the soft structures between the fragments, necrosis, and in compound fracture considerable loss of substance, as when fragments have been extracted, or bone has, to facilitate reduction, been cut away; the ligature of the main artery for hæmorrhage; and, probably, injury of the large nerves of the limb. The second comprise atrophy, as in the very old, or that which occurs from long disuse, scurvy, the advanced cachexia of syphilis, or that attending the later stages of cancer, and, according to some observers, pregnancy. The influence of these causes has, doubtless, been exaggerated. *See* UNUNITED FRACTURE.

Consequences of Fracture.—Fat-embolism may occur after fracture involving the medullary canal. *See* FAT-EMBOLISM. Necrosis is extremely rare, if, indeed, it ever occurs, after simple fractures. In compound fractures it is not rarely met with. It may be suspected in cases in which, though the surrounding structures have become sound, openings leading down to the bone remain long unclosed. Under these circumstances an examination involving as little disturbance as possible should be made, and any dead bone that is discovered should be removed. Sequestra generally consist of fragments of compact tissue. They may sometimes be extracted more easily when divided by a fine chisel. The rapid development of new-growths in the site of recent fracture is to be noted. Atrophy, sometimes very marked, may follow the interruption of the blood-supply to the bone, resulting from rupture of its medullary artery. For individual fractures, *see* separate bones. HOWARD MARSH.

FRAGILITAS OSSIUM.—This is an old term, which has gradually fallen out of use as the more exact pathology of the various conditions under which the bone is more than usually brittle has become better known.

The chief morbid process with which it was most frequently confounded—osteomalacia—will be considered in another article. Fragility was scarcely a proper term to apply to cases of osteomalacia, for the bones more frequently bend into all sorts of odd shapes in the latter disease than break with a clean fracture. Simple atrophy of bone from various causes will here alone be considered as the condition giving rise to fragilitas ossium. Cancer and tumour of bone, in which spontaneous fracture occurs, will be considered under their proper heading of TUMOURS OF BONE.

Causes.—In old age the bones, like other tissues, undergo fatty degeneration, and, becoming more brittle, are liable to fracture from insignificant injuries. Long confinement to bed during a lingering illness in the adult, will sometimes produce the same effect; that is to say, the bone may atrophy from want of use, and become so brittle as to break. It is also well known to surgeons how light and porous the bones of a limb become in which one or more joints have been diseased and kept at rest for any length of time.

This atrophy from disuse may in some degree explain the ease with which a patient who has been kept in bed for six weeks or two months for fracture of the femur breaks the other thigh-bone, when he gets up and begins to move about. The bone may even break in the neighbourhood of the original fracture from the same cause. And Curling has shown very clearly that another factor plays an important part in such atrophy. He maintains that when the line of fracture crosses the nutrient artery, the osseous tissue supplied by that vessel undergoes atrophic changes.

In insane patients, and especially in cases of general paralysis, the bones sometimes break from very slight injuries. And although there is frequently some little difficulty in proving the absence of any undue violence on the part of the attendant, yet it is an established fact that the bones may be very fragile. This is generally due to atrophy and fatty degeneration, arising probably from the low and depressed vital condition of such patients. It has been asserted that the bones may be found in the condition described as osteomalacia; but, in the writer's opinion, there is insufficient evidence that this is by any means common in the fragilitas ossium of the insane.

A somewhat similar condition of atrophy and thinning of the bones has also been observed in the advanced stages of carcinoma, especially in that of the breast, without any deposit of new-growth in their substance. The cachexia induced by the carcinoma would seem here to be the cause of the atrophy and consequent fragility. In some cases rheumatism or syphilis has been present before the occurrence of such evidence of a feeble condition of the bones. But in others no history of these constitutional affections has been obtainable. Some of the cases referred to by Stanley are remarkable for the extraordinary number of fractures, and the early age at which they occurred. In one, a girl of fourteen, there were no less than thirty-one fractures in different bones, the first occurring at the age of three years. 'In a sister of this patient, six years of age, there was the same condition of the bones favouring the occurrence of fractures. She had suffered nine fractures since the age of eight months.' In another, to which he alludes, a boy aged ten years had been the victim of eight fractures—six in one tibia, and two in the femur. There was no difficulty in obtaining their union, a fact which is quite unlike the history of cases of osteomalacia. A decided hereditary tendency to this condition of the bones has been proved to exist in a small proportion of the cases recorded. In infantile paralysis the affected limb may exhibit the same symptoms from a feeble condition of the bones, but this is due to a want of development from disease of the spinal cord.

Pathology.—In the atrophy of old age the bones become light, spongy, and more porous. The spaces in the cancellous tissue coalesce by absorption of the osseous trabeculæ, whilst the cortical tissue becomes more and more cancellous, till finally the bone may be reduced to a mere shell filled with yellow fat. In this senile atrophy the lime-salts are not absorbed, leaving the organic matrix to represent the bony outline, as occurs in the early stage of most, if not all, the cases of osteomalacia; but, on the contrary, the part which has not yet entirely disappeared, and been replaced by fat, contains more than the usual proportion of lime-salts, and is consequently more brittle. In osteomalacia, on the other hand, the texture of the bone is at first softened by the absorption of its lime-salts, and bends rather than breaks. So much for the contrast between senile atrophy and osteomalacia. The question then appears to be whether atrophy of bone, arising from other causes than simple old age, is similar in its pathology to senile atrophy or to osteomalacia; and secondly whether there is a fragility of bone besides that due to osteomalacia, occurring in young or middle-aged people, to which no definite cause can be assigned other than simple atrophy of bone. To the first of these questions the answer would seem to be fairly definite, that the atrophy and consequent fragility arising from some definite cause, such as long-continued disuse, resembles most completely the changes occurring in senile atrophy. To the second question a less definite answer must be given, as the cases are so excessively rare that few can have been observed by any one man.

The cases recorded by Stanley would seem to indicate that there is an atrophic condition of bone, occurring at almost any age, resembling, in its morbid anatomy, the changes naturally arising in old age, and to which no definite cause, such as disuse, can be ascribed. Stanley thus concludes: 'Still, however, it is not clear that this condition of the bones, disposing them to fracture from the slightest causes, is a different disease from that which was previously described (osteomalacia), wherein the thinning of the walls was accompanied by softening of the texture of the bones, disposing them to bend rather than to break, since between these two states of the osseous system there is really no other observable difference than in the relative proportions of the animal and earthy constituents of the affected bones; their chemical constitution is the same.' But, in the writer's opinion, this is quite a sufficient difference to separate the two conditions of atrophy of bone and osteomalacia, especially when the clinical symptoms and history of the latter are taken into consideration. *See* Osteomalacia.

Symptoms.—Beyond the lightness of the affected bone, and the tendency to fracture from trivial causes, there is nothing to point out as indicative of atrophy of bone. The surgeon will, however, know from the history of the case—for example, in continued disuse of a limb from any cause—that the bones so treated are liable to atrophy, and consequently may be easily broken. In the other class of cases, in which the atrophy seems to arise spontaneously from no ascertainable cause, the first indication of the presence of the disease will be the occurrence of fracture from some trivial accident.

Treatment.—In senile atrophy, and in atrophy from other causes, the bones very readily unite. Professor Humphry has lately (*Brit. Med. Jour.*, Feb. 1884, p. 55) proved that in old people fractures unite as readily as in the young and middle-aged; and in the atrophy from other causes than age, the histories of the cases which have been recorded tend to prove that there is no delay in their union. It is therefore necessary to treat these fractures exactly on the same grounds as ordinary fractures, except that the surgeon should most carefully search for any clue in the patient's history pointing to a constitutional cause, and attempt, as far as possible, to rectify the defect if such be found. There cannot be said to be any special treatment even when the atrophy giving rise to the fragility of bone is discovered.

H. H. Clutton

FRECKLES. *See* Lentigo.

FRICTION. *See* Massage.

FRONTAL SINUS, Diseases of the.—Distension of the frontal sinus from pent-up secretion, or pus, sometimes called abscess of the frontal sinus, may so closely resemble an orbital tumour as to render a diagnosis difficult without making an exploratory incision.

Causes.—Distension of the frontal sinus is usually due to an injury, in many cases very remote from the symptoms which first attracted attention to the eye. The extent, however, to which the sinus is often found dilated, and the time which must be required to produce such distension of a bony cavity, together with the oft-told tale of a blow or fall years before, can only lead to the conclusion that an injury is the most frequent exciting cause of these accumulations. The explanation is probably that at the time of the accident some of the anterior ethmoidal cells were fractured, and that the infundibulum, the canal by which the secretion from the frontal cells escapes into the nose, had been blocked. This channel being thus closed, there is retention of all mucous secretion, which slowly accumulates and gradually expands the sinus. In one case of extreme distension of the frontal sinus in a man æt. 58, under the writer's care, the disease was clearly traced to a kick received on the left eyebrow from a horse when four years old, fifty-four years previously. The left eye was considerably displaced by the tumour; it was half an inch further from the nose, and nearly an inch lower down in the face than its fellow on the opposite side. The eye was projected outwards, and the patient was unable by any effort to draw it inwards. This case was greatly benefited by treatment, and the eye regained to a large extent its proper position within the orbit.

A case has also been recorded by Mr. Hulke of a girl æt. 17 with great expansion of the right frontal sinus, which was evidently caused by an accident when she was four years old. 'She fell from a window and received a cut over the right eyebrow. Her forehead was much bruised and swollen, and she had concussion of the brain.'

There are, however, cases of distended frontal sinus in which no history of an injury can be traced. It is probable that in these cases an inflammation of the lining mucous membrane, or some other cause which we cannot detect, has closed the communication between the frontal cells and the nose, and thus allowed the secretions of the frontal sinuses to accumulate and distend them. This hypothesis is the probable explanation of a case of great distension of the frontal sinus in a girl æt. 21, who was attending at the Royal London Ophthalmic Hospital, and who had never received an injury. Her mother dated the disease from an attack of erysipelas of the head and face when she was six years old.

Symptoms.—In most cases the distension of the frontal sinus is *chronic*, the collection of fluid within its walls being the pent-up secretion of many years. Sealed up in a bony cavity no decomposition of the fluid ensues, and, increasing year by year in quantity, it distends the sinus and displaces the eye. There is frequently no pain, not even a sense of weight over the brow. The only symptoms which are manifest to the patient are the gradual formation of a tumour at the upper and inner portion of the orbit, and a slow but steadily increasing protrusion of the eye downwards, outwards, and forwards. The disease is usually confined to one frontal sinus, but cases have been met with in which both frontal sinuses were affected. Occasionally a chronic distension of the frontal sinus will become acutely or sub-acutely inflamed, and there will be a feeling of constant heaviness and aching across the forehead, with tenderness on the inner side of the orbit, which will compel the patient to seek for advice.

Acute inflammation and distension of the frontal sinus is rare, but still it does occur and should be recognised. There is a dull aching pain over the brow and root of the nose, accompanied by considerable constitutional disturbance. The pus gradually accumulates in the frontal sinus, and ultimately discharges itself either by bursting into the nose, or by making an exit for itself through the upper and inner part of the orbit. When the latter site is selected there is usually some bulging of the distended sinus into the orbit, and a slight displacement of the eye downwards and outwards. The upper lid becomes red and swollen, and the tumour, examined with the finger, is tender, and will, if sufficient thinning of the bone has taken place, impart a sense of fluctuation.

Treatment.—The objects to be attained are, first to evacuate the pent-up fluid, and then to establish a free communication between the frontal sinus and the nose, through which the secretion may continue to drain as fast as it is secreted. By these means the cavity of the sinus will gradually collapse, and the eye will be restored in a great measure to its normal position. The ends to be desired will be accomplished by the following operation:—

A single curved incision parallel with the fold above the lid is to be made over the most prominent part of the tumour, and having by a little dissection exposed its surface, the scalpel should be plunged into it, and an opening made to the extent of the incision. The index finger of the right hand is now to be pushed into the sinus through the wound, to ascertain the size of the cavity and if there is any necrosed or carious bone. Whilst thus exploring the sinus, the little finger of the left hand should be passed up the corresponding nostril, and an endeavour made to find out the spot at which the tip of the finger in the sinus will approximate most closely the end of the one in the nose. After a little search it will be found that at one part the fingers will almost meet, there being only a thin plate of bone between them. Having gained this information, the finger in the frontal sinus is to be withdrawn, but that in the nostril is to be retained *in situ* to act as a guide to the gouge or elevator, which is to be passed into the sinus and made to force a passage into the nose through the lamina of bone on which the tip of the little finger is resting. A communication between the frontal sinus and the nose having been thus established, an india-rubber drainage-tube, with holes cut at short distances, is to be introduced, one extremity of which is to be afterwards fastened on the forehead, whilst the other end protrudes slightly from the nostril.

The easiest way of introducing the drainage-tube is to pass a probe with an eye up the nostril and out of the wound, and having fastened the tube to it by means of a piece of string, to draw it back again through the nose.

The object of the drainage-tube is to keep the channel between the two cavities from closing, and to enable the attendant to wash out the frontal sinus at least twice a day with some astringent and disinfectant solution. For the latter purpose a lotion of alum gr. iij., sulphate of zinc gr. j., to the ounce of water; or a lotion of carbolic acid ♏iij. to the ounce of water, may be injected with a glass syringe through one of the openings at the upper extremity of the tube. The drainage-tube should be worn for five or six months, or until all discharge from the nose has ceased. The results of these cases when thus treated are usually most satisfactory.

Tumours of the Frontal Sinus.—The tumours which are met with in the frontal sinus are—

1. Those which originate in the frontal or ethmoidal cells; or, in some cases, in the sphenoidal cells at the base of the skull. These are usually bony or ivory exostoses.

2. Those growths which originate in the nose, antrum, or adjacent locality, and afterwards extend into the frontal sinus.

1. Ivory exostosis is the tumour most frequently met with in the frontal sinus. It grows in two ways:—

(*a*) As a sessile tumour, which is connected with the portion of bone from which it sprang by a very small pedicle; it then occasionally becomes detached, and remains as a loose bony tumour within the cavity of the distended sinus.

(*β*) As a tumour with a broad base, which increases with the growth of the tumour.

Ivory exostoses in their growth extend forwards and downwards into the nose and orbit, and frequently also backwards into the cavity of the skull.

A case of large ivory exostosis was reported by the late Sir William Fergusson. The weight of the bony growth removed was 10½ ounces, or 5,040 grains. Another case has been related by Dr. Duka. The weight of the bony growth removed was 1,060 grains.

Mr. Bryant, in his *Practice of Surgery*, has also recorded a case of ivory exostosis which he enucleated from the frontal sinus of a man æt. 24, which had been growing for four years.

Treatment.—In all cases of bony growth within the frontal sinus it is necessary to proceed with extreme caution. When the tumour is connected by a very small pedicle with the adjacent bone, it may generally be easily detached and turned out; but if it is found to be connected by a broad base to the cranial bones, it is better to make no further attempt to remove it.

2. Of the tumours which originate in the nose, antrum, or adjacent locality, and extend into the frontal sinus, we have:—

(*a*) The polypoid growths. These may start from the nose and extend upwards into the frontal sinus, and completely distend it so as to form a tumour, bulging the inner wall of the orbit and displacing the eye.

(*β*) The fibroid polypi, which grow from the base of the skull and make their way into the nose. These also sometimes extend themselves into the frontal sinuses.

A very remarkable case of a large tumour which occupied the nose, both frontal sinuses and upper maxillary bones, was reported by the late Mr. Moore, of the Middlesex Hospital, in the *Pathological Transactions*, vol. xix. p. 332, under the heading of Cranio-facial Enchondroma. The deformity in this patient was excessive. Both eyes were displaced outwards, and the width between the inner angles of the two eyes was four and a half inches. There was a huge protuberance of the upper part of the face, caused by the distension of the cavities which were filled with the tumour.

The tumour was examined by the Morbid Growths Committee of the Pathological Society, who described it as a compound growth of myxoma and enchondroma. The preparation is in the Middlesex Hospital Museum, No. 539.

Fracture of the frontal and ethmoidal cells is occasionally produced by blows on the face. The injury is recognised by an escape of air into the cellular tissue of the face on the patient forcibly blowing his nose.

Treatment.—The patient should not blow his nose, and in a short time the emphysema will entirely disappear, and in a few days the fissure in the bones through which the air escaped will be completely closed.

George Lawson.

FROST-BITE.—Any uncovered part of the body when exposed to the continuous action of intense cold becomes at first red and tender, next hard, white, and insensitive, and at last passes into a state of dry gangrene. In frost-bite which is caused by the action of cold air on peripheral and exposed organs, such as the nose, external ear, and fingers, the lesions are not so rapidly produced, and each of the above stages is well-marked and more or less prolonged. In a division analogous to that of burns the lesions produced by the action of cold were arranged by Callisen in three degrees: the first, of erythema; the second, of vesication and superficial ulceration; and the third, of gangrene.

In the erythematous state the well-known condition is met with, in which the skin is rendered deep red or livid on temporary exposure to a frosty air, and subsequently, when warm, becomes very painful and slightly swollen. In the second degree, caused by more prolonged or frequently renewed application of cold, the epidermis is raised in small blisters and the skin becomes raw. In the extreme forms of this degree the whole thickness of the cutis becomes inflamed, large blisters containing blood-stained serum are formed, and the affected surface is threatened with complete disorganisation.

Gangrene from frost-bite presents a variety of forms, and is influenced by the intensity of cold, the duration of its action, and the condition of the affected part. In the very rare instances in which it is caused solely by the action of very intense cold, the frozen skin first becomes white and firm, like a surface acted upon by the ether spray, and then passes into a state of dry gangrene, the integument becoming black and inodorous and hopelessly disorganised. In the more frequent form of frost-bite the gangrene is moist, and due either to too rapid application of warmth to a livid and incompletely frozen surface, or to the prolonged action of moderate cold combined with wet. In some few instances the gangrenous part becomes 'mummified,' being quite dry, though soft and pliable, and separating very slowly from the adjacent sound parts.

In most cases of gangrenous frost-bite the causation is complex, as the action of cold is assisted by that of other conditions. Debility from insufficiency of nourishment and from fatigue has undeniable influence, as is proved by the records of military surgery, and by the fact that frost-bite, once so prevalent amongst Lascars, is now very seldom observed in the crews of the well-manned and well-provided steamers which make short voyages between the East Indies and English ports. In enfeebled and aged subjects of arterial degeneration, as also in the younger subjects of *gangrène symétrique*, the application of but a moderate degree of cold may cause destructive changes in toes or fingers. Occasionally with the action of cold is associated that of compression of the chilled extremity, as in the not infrequent occurrence of gangrene of the toes in a patient who, after prolonged exposure to cold and wet, had fallen asleep without removing his boots. A dry and still air, however cold, is less likely to cause frost-bite than cold associated with wind and moisture.

In *treating* frost-bite of that grade in which the skin is of a deep red or a livid tint and has not yet become black and gangrenous, the medical attendant should apply warmth very gradually, and trust at first to prolonged friction with snow or sponges dipped in iced water. As the skin becomes warmer and less congested, the frozen part should be enclosed in dry flannel or cotton wool. Often, after a frost-bitten part has been found quite cold and livid and apparently dead, the whole or much of this threatened organ has been saved through great care having been taken in restoring warmth and in controlling the inflammatory reaction.

When a portion of a finger or toe has been destroyed by frost-bite, it is advisable to allow the gangrenous part to come away by itself, or, at the most, to interfere only when it is retained by ligament or bone. In gangrene of a larger portion of an extremity, as of more or less of the foot for instance, it becomes necessary in order to prevent any septic poisoning, to remove the destroyed parts as soon as this can be done without much danger to the adjacent tissues. In most cases it will be found advisable to wait for a time and to perform a secondary amputation. The structures above the seat of gangrene remain affected for some time after the application of cold, and from the direct action of any stimulus may themselves become gangrenous. By the time that a distinct line of demarcation has formed, the sound parts beyond have very probably returned to their normal condition, and may now form sound and useful flaps. In a case of decided gangrene, from intense cold, of a considerable portion of either the lower or the upper extremity, primary amputation is indicated.

W. JOHNSON SMITH.

FUMIGATION. *See* CALOMEL VAPOUR-BATH.

FUNGOUS DISEASE OF INDIA (*Synon.*: Madura foot; Mycetoma).—*Definition.*—An endemic disease affecting the extremities, producing disorganisation of all the tissues.

Etiology.—The disease is endemic in certain parts of India, but is not limited to any particular soil or geological formation. Hitherto it has been limited to natives, especially those who go barefoot and work in the fields; it is much more frequent in men than women, and is rare below puberty, but may occur at any age after that. In many instances the patient dates the onset from an abrasion, prick, or other slight injury, but it is often impossible to trace it to any cause, either predisposing or exciting. A previous attack of guinea-worm disease, though not infrequent, can scarcely have any etiological bearing.

Varieties.—Two varieties are recognised, the pale and the black, the black being the most common; but the only difference is in the colour of the granules and the presence or absence of fungus-elements.

Pathology.—The pathology is still obscure. Vandyke Carter considers the disease to be due to a fungus, named after him Chionyphe Carteri; but since his discovery has only been confirmed in the black variety, it leaves the pale form unexplained, and the presumption therefore is that the disease is not due to the presence of the fungus; at the same time, no other theory offers any semblance of plausibility. When a section is made of a diseased foot it is often difficult to make out the various tissues, on account of the fatty and fibrous degeneration they have undergone, many even of the bones having disappeared and been replaced by fibrous tissue; the muscles are the least affected, and the fat is often much increased, but may contain black or coloured granules. The foot is perforated by sinuses in all directions, which pierce even the bones as if they had been drilled, often with no surrounding degeneration of the bone-substance; the sinuses lead into small spherical cavities, single or multiple, containing an abundance of granules, which stud the walls of the sinuses and lie free in their lumen.

The granules consist of altered fat, with a central caseous mass, surrounded by fatty crystals, while the black granules are made up chiefly of the mineral constituents of the tissues, with black pigment derived from the blood-colouring matter, and an abundance of the fungus alluded to.

Symptoms.—The tumour is single, and in the vast majority of cases affects the foot or leg, sometimes the hand or arm, and in rare instances the shoulder or scrotum. In a well-marked case the foot is enormously swollen and distorted, from the bones of the foot giving way, so that the arch is destroyed and the toes are over-extended. On various parts of the surface are pea-sized projections, and the centre of each is the orifice of a sinus leading into a cavity, which may be either superficial or deep. From these sinuses issues a sero-purulent discharge, containing the granules compared to fish-roe, which are white, yellow, or black, according to whether the case is one of the pale or black form, and in rare instances the granules are pink or red; they also stud the surface of the eminence round the orifice.

The mode of commencement varies. Only a finger or toe may be attacked first; or, affecting the body of the foot, there may be very little swelling or redness and circumscribed induration; or a papule, pustule, or tubercle appears, which may be superficial or deep, firmer, larger, and less tender than a boil, which, when opened, discharges ordinary pus at first, and later on the characteristic granules above described. Or there may be mottled discoloration under the skin like tattoo-marks, before any wound appears. The disease progresses slowly, as a rule, and it may be six or seven years, or more, before the foot becomes thoroughly disorganised, though it may have been useless for progression for a long time.

Diagnosis.—The fully developed disease, with its enormous swelling, its limitation to an extremity, and the numerous sinuses, with the characteristic discharge of 'fish roe' granules, offers no difficulty. The cases beginning with 'gunpowder grains' under the skin are also distinctive, but those with a pustule or tubercle are very like the guinea-worm disease; and probably it might be difficult to decide until the pustule was opened, when the absence of the worm and the character of the discharge would clear up the diagnosis.

Prognosis.—The disease is slowly but steadily progressive if untreated, and the whole foot or hand becomes completely disorganised and a useless and painful encumbrance.

Treatment. — When the disease is limited, removing the toe or finger may be sufficient; or, in the early stage, when the process is superficial, scraping all the affected tissue away with a sharp spoon has effectually arrested its progress in several instances; but in more advanced cases the limb must be amputated above the disease. The operator, however, is sometimes disappointed to find the bones of the leg softened beyond the apparent limit of the morbid changes, and has, therefore, to remove more than he anticipated.

H. Radcliffe Crocker

FUNGUS OF THE BRAIN. *See* Brain, Hernia of the.

FUNGUS OF TESTIS. *See* Hernia Testis.

FURUNCULUS. *See* Boils.

FUSIBLE CALCULUS. *See* Calculus, Urinary.

G

GALACTOCELE or MILK CYST.—The term galactocele has been applied to three pathological conditions, of the existence of two of which grave doubts must be entertained. The true galactocele is caused by the obstruction of a duct during lactation. The obstructed duct becomes dilated by the secretion, and a cyst is thus formed, giving rise to a fluctuating swelling which is most superficial near the nipple. The tumour appears during the first few weeks of lactation without any of the signs of inflammation. It has been known to reach an enormous size, as in the celebrated case recorded by Scarpa, in which it rested on the patient's knees when she was in a sitting position, and contained ten pints of pure milk. Galactocele is undoubtedly very rare.

Velpeau describes a form of 'galactocele,' in which the milk was distending the meshes of the connective tissue of the breast, but the evidence he gives in support of the existence of such a condition is not sufficient.

The third form of galactocele which has been described, is that in which the contents have become converted into a material like cheese. Most, if not all of these cases, have probably been chronic abscesses.

Treatment.—A true galactocele is best treated by repeated aspiration, if the cyst be large, to diminish its bulk, after which it may be punctured, and a drainage-tube inserted. It may be necessary to wean the child and arrest the secretion of milk, to effect a cure. MARCUS BECK.

GALACTORRHŒA. *See* BREAST, Diseases of the.

GALL-BLADDER, Obstruction of the. *See* CHOLECYSTOTOMY.

GALL-STONE, Extraction of. *See* CHOLECYSTOTOMY.

GALVANIC CAUTERY. *See* CAUTERY.

GALVANO - PUNCTURE. *See* ELECTROLYSIS.

GANGLION is the name given to a limited collection of fluid which is found in connection with the sheaths of tendons, and is most commonly situated on the back of the wrist, and therefore in relation to one of the extensors of the thumb or of the fingers. It is as common in youth as in adult age, and its causation is not very definite. In some cases it may be ascribed to excessive use of the fingers, as in wringing or in piano-playing, but as often as not its origin is spontaneous. When situated on the dorsal surface it forms an even, globular swelling, fluctuating, not painful, but causing some weakness in the muscles with which it is connected. But when placed on the anterior aspect, the shape is not so distinct, and care must be taken to distinguish it from one of those protrusions of the synovial membrane of the wrist-joint which are sometimes found, and are situated usually beneath the radial artery. Another origin to which the existence of ganglia has been traced is the protrusion, through a rupture of the sheath, of some portion of the synovial sac, which, if healing of the rupture take place, is shut off, and its connection with the parent sac becomes obliterated. In most instances the contents are a clear transparent white or yellow homogeneous jelly; but when the effusion is large, there are frequently found numerous small round or oval bodies, resembling melon-seeds, which consist of a collection of fibrine, and have no organisation. Their presence before evacuation can be ascertained by a crepitation on movement of the part, which is almost unmistakable. They originate from small depositions of fibrine on the inner surface of the sac, which become rolled off by the constant movements of the tendon.

The compound palmar ganglion is a much larger collection of the same materials, which forms in the sheath of the flexor tendons, and passes beneath the annular ligament, above and below which the contents can be made to fluctuate. This sometimes attains a very large size, and may arise gradually from over-work, or from a sudden exertion, as in the case of an attendant struggling with a violent lunatic.

Diagnosis.—These chronic swellings need to be distinguished from the acute inflammation of the synovial sheaths—tenosynovitis—which occurs after such violent exertion as rowing, &c., and are evidenced by their acuteness and by the ordinary symptoms of inflammation. From disease of the wrist they must be distinguished by their situation, shape, and by the absence of other symptoms of disease of the joint.

When small and on the back of the wrist, a ganglion can often be ruptured by pressure of the surgeon's thumb, or by a smart blow from a broad instrument, and the contents are then poured out into the surrounding tissue. But if it resist this, the fluid should be evacuated by a fine trocar or grooved needle, or a sharp-pointed tenotome, and the puncture sealed with collodion. In case any return of the collection is threatened, a blister may be applied, or an absorbent ointment, containing Ung. hyd. ʒj., Ung. pot. iod. ʒj. to Ung. simpl. ℥j., may be frequently rubbed over the part until the skin is reddened. When, however, the collection is large, or when the existence of melon-seed bodies can be ascertained, an incision should be made under antiseptic precautions, and the contents evacuated completely, after which pressure by strapping must be applied and rest of the part maintained. Sometimes after the sac has been incised it may be necessary to scrape off any collections adhering to the walls, and to keep the opening patent by a drainage-tube or a wisp of horsehair.

John H. Morgan.

GANGRENE is a term employed to denote the death of a part of the living body. It implies the destruction of a considerable portion of tissue *en masse*, in contradistinction to ulceration, where, although there may be as great a destruction of tissue, the part is destroyed slowly by molecular disintegration, and there is no palpable mass of dead material, the portion destroyed being thrown off in minute particles in the form of discharge. The mass of dead matter which is the result of the process of gangrene is termed a *slough*.

Causes.—The immediate cause of gangrene, in almost every instance, is the arrest of the flow of blood in the part, but the causes which may give rise to this arrest are very numerous. It may be due to injury, or arise from constitutional causes, or from the two in combination, or it may be occasioned by specific influences. These various causes may be tabulated in the following order:—

Local Causes.—1. Mechanical injuries. 2. Chemical injuries. 3. Heat and cold. 4. Local poisons. 5. Arrest of circulation. 6. Intense inflammation. 7. Pressure or tension.

Constitutional.—1. Deficient blood-supply. 2. Impaired nutrition. 3. Loss of nervous power. 4. Spontaneous. 5. In diabetes. 6. From ergot.

Specific.—1. Carbuncle and boil. 2. Noma and cancrum oris. 3. Malignant pustule. 4. Glanders. 5. Spreading traumatic gangrene. 6. Hospital gangrene.

Local Causes of Gangrene.

1. *Mechanical injuries* are frequent causes of gangrene, the injury being of such a nature as to destroy the vitality of the tissue, so that its functions can no longer be carried on; hence the part dies and separates as a slough. This process may be seen daily, in a minor degree, in contused and lacerated wounds. The blow which produced the wound kills a thin layer of tissue, which must separate as a slough before the wound can heal. Occasionally the violence done to the part is so great that it kills its whole substance, as, for instance, in the case of the wheel of a heavy waggon passing over a limb; here the tissues are so destroyed that all circulation immediately ceases, and the part speedily falls into a condition of gangrene. At other times the injury may not be so great as to kill the tissue outright, but the vitality is so impaired that the inflammation necessary for recovery terminates in gangrene. But whether the gangrene occurs in the one way or the other, the immediate cause of it is the arrest of the circulation in the part.

When a part has been severely contused and is about to fall into gangrene, it is generally of a dark purplish colour, cold to the touch, and devoid of sensibility. The symptoms, in a great measure, will depend upon the amount of blood which has been extravasated into the tissues. When this has been poured out in large quantities the part is swollen, black or purplish-black, and soft and boggy to the feel. The temperature falls, the limb becoming cold and insensible. Bullæ, filled with blood-stained serum, form on the surface, and the part rapidly falls into a condition of decomposition. Emphysematous crackling may be felt, from the evolution of gases, and a fetid, stinking odour is perceptible.

2. *Chemical agencies* also cause gangrene in the same way, by destroying the tissue so that the blood can no longer circulate through it. This they do either by combining with the animal matter, so as to form a new compound; or else by causing the elements of the animal tissue to enter into new combinations, and thus destroying the life of the part. A familiar example of this is the common issue, where the desiccating action of the potassa fusa destroys the tissues with which it is brought into contact.

Where the gangrene is produced by the application of a caustic, the process partakes more of the dry form. In fact, the gangrene produced in forming an issue forms a typical example of 'dry gangrene,' in which the process can be well studied; the desiccating action of the potassa fusa drying up the fluids in the part, and thus destroying the tissues with which it is brought in contact. If an issue be examined a day or two after its formation, the dead tissue will be found to be quite black and somewhat shrunken, so that the cavity in which it is contained appears to be somewhat cup-shaped, and there is no discharge and no fetor. Shortly after, a halo of redness appears in the natural skin around, and the slough begins to separate.

3. *Heat and cold* produce gangrene, the amount varying with the intensity and the duration of the application. It may merely involve the cuticle, or it may destroy the whole limb; but the principle is the same—gangrene is produced in the one case as much as the other. Gangrene from frostbite may occur either from the direct effect of the suspended circulation, or from inflammation which subsequently ensues after the circulation has been re-established. *See* BURNS; FROST-BITE.

4. *Local poisons*, as the extravasation of urine or fæces, may lead to gangrene. A familiar example of this is seen in cases of ruptured urethra from stricture, where the concentrated and putrefying fluid is effused into the cellular tissue in the neighbourhood, producing death of this tissue and, secondarily, of the skin from deficient supply of blood, owing to the circulation through the cellular tissue being arrested.

The skin, at first of a dusky-red hue, speedily becomes purple, and gangrenous spots appear. These give way and large masses of pultaceous, sloughing material are separated, accompanied by quantities of foul-smelling discharge. In these cases there is always great general depression; the patient is delirious, with exceedingly feeble pulse and dry, brown tongue, and often sinks from exhaustion.

5. *Arrest of circulation.*—As has been already stated the immediate cause of gangrene, in almost all cases, is the arrest of the flow of blood in a part and the stoppage of the supply of nutritious fluids, and this is due to the suspended circulation in the capillaries, as in the causes already, and still to be, enumerated. Under the heading 'arrest of circulation' are included those cases in which this suspension of circulation in the capillaries is produced by an arrest of supply of arterial blood to a part, or the obstruction of the circulation through, or retardation of the flow of venous blood from, a part. For obstruction of a main artery can only be the cause of gangrene when the collateral circulation is impossible, and therefore the capillary circulation is suspended; and in order that gangrene may result from venous obstruction it is necessary that complete stasis in the capillaries should exist as the result of complete plugging of the veins returning blood from a limb. Thus ligature or obliteration of an artery is not necessarily followed by gangrene, nor will it occur so long as the capillary circulation can be maintained. Nor will obstruction of a single vein cause gangrene, because there is in almost all parts of the body a double channel of superficial and deep veins, which freely intercommunicate, so that if one channel become closed, the other will probably be, at all events partially, open. Under certain circumstances, however, arrest of the circulation through the arteries or veins will produce arrest of the capillary circulation in a part, and then nutrition will cease, and gangrene be the result. Complete arrest of the circulation both from and to a part would of necessity cause capillary stasis, and would result in gangrene. A ligature tied tightly around a limb would produce gangrene in this way; the mortification of a strangulated hernia would depend upon the same cause. The arrest in the supply of arterial blood to a part may be produced by obliteration of the artery by accident, by ligature, by embolism, or by calcification. The return of the venous blood may be retarded or obstructed by inflammation, by thrombosis, or by pressure on the venous tract.

In the cases in which the primary cause of the gangrene is venous obstruction, the limb swells and becomes œdematous, and vesications form on its surface. The skin, at first deeply congested, speedily becomes purplish and then black. The discoloration, commencing at the point furthest from the centre of circulation, extends up the limb. The discoloured parts become cold and insensible, and gas is evolved from the decomposing tissues, which eventually become converted into a deliquescent putrid mass.

When the gangrene occurs from a thrombus or embolus, it is of the dry kind. This condition not infrequently occurs in cases where vegetations on the cardiac valves, the result of endocarditis, are washed into the arteries, and become arrested when the calibre of the vessel is no longer sufficiently large to permit their onward progress. Its advent is generally sudden and it affects one limb. The patient is suddenly seized with severe pain in the course of an artery, where it diminishes in calibre either by bifurcating or by giving off a large branch. This is followed by numbness and weight in the limb. The part 'feels dead.' It is sensibly colder than the rest of the body, and has a shrunken and white, waxy appearance. No pulsation can be felt in the arteries below the seat of obstruction. At first the boundary line between the dead and living tissues is not clearly defined, but in the course of a day or two becomes more marked, and can be exactly differentiated. The changes take place slowly, the white and waxy skin gradually assumes an olive-green tint, and then becomes black, the blackness, for the most part, appearing in patches which gradually spread. The discoloured tissues shrivel and contract, and the skin becomes hard and horny. There is little or no fetor. At the line of junction of the dead and living parts a halo of redness may now be observed, and the gradual formation of an ulcerating furrow. Later on the soft dead parts may be seen falling away from the living, the tendons resisting the disintegrating process the longest. In this form of gangrene the process is essentially chronic, and is attended by much less constitutional disturbance than in the acuter forms of the disease. In fact, the temperature may remain normal and the pulse good in these cases during the earlier stages of the disease. The formation of the line of demarcation is, however, generally attended with a slight rise of temperature and access of febrile symptoms.

6. *The intensity of the inflammation* of a part may lead to gangrene—that is to say, the inflammatory disturbance of the nutrition of a tissue is sometimes so great as to lead directly to the arrest of tissue-change, and this in its turn leads to cessation of the capillary circulation, and thus gangrene is established. In these cases it is therefore not correct to say that the gangrene is the result of capillary stasis, since, in all probability, death is established before the circulation in the part is arrested, the stoppage of the circulation being the result, and not the cause, of the death of the tissue.

7. *Pressure and tension* will produce gangrene. A practical example of the former is to be seen in a bedsore, brought on by continued pressure in a sick person. Not that all bedsores are produced by pressure; they may be produced partly by loss of nervous influence, or from a maceration of the skin from long-continued lying in a bed wetted with urine or other fluids. The true gangrenous bedsore produced by pressure occurs in debilitated and emaciated patients, who are prevented by weakness from shifting their position, and thus continuous obstruction to the capillary circulation is maintained, and the passage of blood through the parts where the pressure is great becomes mechanically difficult or impossible. Stagnation occurs, and death of the tissues takes place. The blood-vessels in the neighbouring parts become engorged, and the slough, acting as a foreign body, sets up inflammation in them, a gradual process of separation taking place, and the dead tissue is thrown off, leaving an ulcerating surface which only very tardily cicatrises, should the patient survive.

Too great tension of the tissues, leading to a deficient blood-supply, is not an uncommon cause of gangrene. Thus, in cases of phlegmonous erysipelas and diffuse cellulitis, the tension of the cellular tissue leads to deficient blood-supply to the skin, with loss of nutrition, followed by coagulation in the capillaries and consequent gangrene.

There is in these cases great swelling from the effusion into the subcutaneous tissue, and the skin becomes so hard and tense that no pitting on pressure can be produced. The redness is of a dusky hue, and is not uniform, being darker at the centre than towards the circumference. Pain is great and of a burning character. The general symptoms are severe, and often marked by paroxysms and remissions. The pulse is quickened and oftentimes irregular and intermittent; the tongue thickly coated, with a yellow, creamy fur; the urine high-coloured and loaded, and its quantity much diminished.

Constitutional Causes.—One of the most frequent constitutional or general causes of gangrene is (1) *deficient blood-supply* to a part, arising either from disease of the arteries or of the heart, or probably more frequently from the two combined. It is met with usually in the lower extremities of persons of advanced life, and the disease is the result usually of systemic decay. When it arises from this cause it is distinguished by the generic term 'senile gangrene.' In advanced life the arteries become rigid and calcified, and lose their power of adapting themselves to suit the various exigencies necessary for nutrition; this in itself is not sufficient probably to produce the gangrene, but when combined with diminished propulsive power of the heart, so that the circulation, especially in the lower extremities, is weakened, arrest of the flow of blood takes place, and gangrene inevitably follows. It appears, however, that the immediate cause of the arrest is sometimes a slight injury, such as an abrasion or some such trivial lesion, which is the starting-point of the disease. It seems as if the tissues were just sufficiently nourished to maintain their vitality, and that the slight injury destroys the balance of the circulation, and, as a result, gangrene ensues.

The disease is usually ushered in by the appearance of a dark red or purplish spot at the seat of the injury, or on one of the toes, generally the inner side of the great toe. This is surrounded by an areola of dusky red tissue, and is accompanied by a smarting and burning pain of a paroxysmal character. The gangrene advances by involving the inflamed areola, and as the whole toe becomes involved, it shrinks and becomes smaller. In this way the disease extends, gradually invading one toe after another, until it implicates the foot, and unless arrest takes place and a line of demarcation is set up, it may extend up the ankle and leg. Frequently, however, if the patient should survive, the gangrene becomes arrested in the neighbourhood of the ankle-joint, at about the situation of the division of the posterior tibial vessels, and a tolerably clearly defined line is formed between the living and dead tissues. Here a process of ulceration may be set up, and the parts which have perished gradually separate from the living tissues. Or it may happen that after an apparent line of demarcation has been established, a fresh impulse appears to be given to the mortification, and it again rapidly extends and involves the whole limb. There is generally considerable constitutional disturbance: fever of a low asthenic or irritative type, with depression of the vital powers, and low, muttering delirium; and the disease frequently terminates fatally in a month or six weeks.

2. *From impaired nutrition.*—Under this head is included gangrene occurring in the course of certain severe diseases, especially the exanthemata, which have long been known to produce this result. There seems to be good ground for believing that in some of these cases, at all events, the gangrene is the result of a debilitated condition of the system, consequent on a long illness. The heart in these cases being especially enfeebled is unable to drive the blood, which itself is impoverished and deficient in nutrition to the distant parts of the body, and gangrene is the result, from coagulation of the blood in the capillary vessels. It may be that, in some of these cases of gangrene following the exanthemata, embolism is the immediate cause of the complication. According to Estlander, this is the cause in cases of gangrene after typhus fever, miasmatic thrombi forming in the left side of the heart, and being carried thence into the vessels of the extremities.

3. *Loss of nerve-power.*—There can be little doubt that loss of nerve-power is a cause of gangrene, and that parts deprived of their proper nerve-stimulus may fall into a condition of mortification. A familiar example is presented in sloughing of the cornea, resulting from injury of the fifth pair of nerves, which destroys the nervous sensibility of the part and impairs its nutrition. Two explanations of this phenomena are usually given. One is that this impairment of nutrition depends on some altered state of the vaso-motor nerves, producing, probably, a paralysis of the muscular coat of the blood-vessels and a permanent dilatation; the other, that the change is brought about by irritation of certain special or 'trophic' nerves. It must be borne in mind that even the existence of these trophic nerves is purely hypothetical, and that, if they exist, nothing certain, as to the course they run or the centres they own, is known about them; whereas it is an acknowledged fact that elevation of temperature, the result of hyperæmia from vaso-motor paralysis, is a common sequel of loss of nerve-power, and, according to Professor Schiff, changes in nutrition occur in parts which are the subjects of vaso-motor paralysis.

Mr. Hutchinson has advanced a third theory as to the cause of gangrene as a result of nerve-lesion. He believes that it is due to a condition of spasm of the muscular coat of the blood-vessels, brought about by reflex irritation of a sensory nerve. He quotes, as an example, a case related by Mr. Hilton, where an exostosis on the first rib, pressing on the ulnar nerve, produced gangrene of the little and adjacent side of the ring finger, and states his opinion that the pressure on the ulnar (sensory) nerve was conveyed to the spinal cord, and reflected along the vaso-motor nerves which run in the ulnar nerve itself to the blood-vessels of these two fingers. Mr. Hutchinson also suspects that ordinary senile gangrene begins from defective nerve-supply.

4. *Spontaneous gangrene* is a peculiar form of gangrene affecting the extremities,

which Raynaud first described under the name of 'La gangrène symétrique des extrémités.' As the name implies, the gangrene comes on symmetrically in the two extremities. In a case recorded by Dr. Begg, of Dundee, it attacked both upper and lower limbs. The exact cause of this form of gangrene is unknown, for pathological examination has revealed neither embolism nor blocking of the vessels, nor degeneration of their coats. It occurs for the most part in weakly and anæmic individuals, with extremely feeble circulation, who habitually suffer from cold extremities, and appears to arise from a contracted condition of the capillaries, so that little blood circulates in them, conjoined with a weak action of the heart, so that its propulsive power is reduced to a minimum. *See* ARTERIES, Diseases of.

5. *Gangrene in diabetes.*—Patients suffering from the presence of sugar in their urine appear to be especially liable to be attacked by gangrene, which may come on either spontaneously or follow some slight operation. It appears to commence as an inflammatory process, to which patients suffering from diabetes are peculiarly liable, and which would seem to arise from the diseased condition of the blood, and passes on into gangrene, accompanied by considerable inflammatory action.

Like senile gangrene, it may commence apparently as the result of a slight injury, or may occur spontaneously, appearing as a black spot, generally on the side of the toe, which spreads rapidly, and is accompanied by a considerable amount of inflammation in the tissues around, and often by acute pain.

6. *From ergot of rye.*—The gangrene due to ergotism is supposed to be due to a continuous spasmodic contraction of the muscular coats of the smaller arteries, thus narrowing the calibre of the vessels and diminishing the supply of blood to the part. The disease is almost unknown in modern times, and appears to have been more common in France than in this country.

The disease appears to have presented itself under various forms and types, partaking more of the character of dry gangrene, and rarely presenting the moist variety. It usually commences with itching and tingling of the hands or feet, and cramp coming on from time to time in the muscles of the limbs affected. After a time these abnormal sensations are succeeded by numbness, passing into complete loss of sensation. The fingers or toes, as the case may be, become shrivelled, dry, black, and mummified, and the gangrene gradually extends, and may involve the whole extremity. When the disease is chronic the result is generally favourable, though several fingers or toes, or even a whole limb, may be lost; but in the more acute cases death generally results within the course of a week or ten days.

SPECIFIC GANGRENE.—Under this heading are classed together those cases of gangrene where the disease is believed to arise from some special condition of the blood, or to be due to some miasmatic influence. Such are cases of *noma pudendi* and *cancrum oris*, which are probably due to some specific poison, occurring in the children of the poor, who have been exposed to faulty hygienic and dietetic conditions, and particularly if the child has been previously ill; but occasionally occurring in perfectly healthy children, who have had no previous illness. Such, also, are cases of *boils* and *carbuncles*, where there is gangrene of the subcutaneous cellular tissue following inflammation, set up by some abnormal constituent in the blood. *Malignant pustule* or *charbon*, and *glanders* are also forms of gangrene where the disease is caused by the introduction of a specific morbid poison.

The true *spreading traumatic* gangrene is believed also to be due to the presence of septic organisms, causing a diffuse inflammation extending along the cellular planes or up the course of the veins or absorbents, and rapidly running into gangrene. This unhealthy spreading inflammation is predisposed to by certain diseased conditions or impure states of the blood, arising more especially from disease of the eliminatory organs, particularly the kidneys, or from chronic alcoholism. It seems that in these vitiated constitutions the tissues furnish a soil peculiarly favourable to the growth of organisms which give rise to inflammatory processes.

It occurs only in recent wounds, before suppuration is established, and for the most part manifests itself within three or, at the most, four days after the receipt of the injury. The edges of the wound become swollen and everted, and present a waxy appearance, with vesications along their margins. There is a slight discharge of fetid, brownish-coloured serum, but no suppuration. At this time there is but very little constitutional disturbance, but within twenty-four hours, swelling, tension, and redness appear around the wound, and rapidly spread upwards, especially along the inner side of the limb. The discoloration, at first red, soon becomes of a dusky, purplish hue, and speedily passes into black. The swelling, primarily firm and resisting, becomes soft and doughy, and presents to the fingers the sensation of emphysematous crackling, due to the evolution of gases which are produced by the decomposition of the affected part—the putrefactive process immediately following the death of the tissues. The disease spreads with fearful rapidity, being preceded by swelling and dusky redness of the skin, which speedily becomes purplish-black, and passes on into a condition of hopeless gangrene in the course of a few hours. The disease extends along the cellular planes until it reaches the trunk, when it terminates in death. It differs from other forms of gangrene in presenting no tendency to arrest, or the formation of a line of demarcation.

The constitutional symptoms which rapidly supervene after the commencement of the disease are of the lowest ataxic type. The pulse, at first full and strong, soon becomes rapid and feeble, and after a time irregular and intermittent. The temperature is raised considerably above normal. The skin becomes yellowish and the countenance contracted and sunken, the face presenting a peculiar leaden hue. There is often constant vomiting, accompanied by hiccough, and the tongue is dry and brown. The abdomen becomes tympanitic, and there is a sensation of constriction around the præcordium. A deep-seated, tensive, burning pain is complained of in the limb. Soon muttering delirium, with jactitation of the limbs, comes on, followed by coma, and death almost invariably ensues in three or four days after the invasion of the disease.

Hospital Gangrene is due to a specific cause, the introduction by inoculation into the system of a contagious material, which by its presence is the cause of the progressive destruction of the tissue.

All these forms of gangrene due to a specific septic cause will be considered under separate headings, to which the reader is referred.

Pathology.—In considering the causes of gangrene, it has been stated that almost all forms commence by a stasis or arrest of circulation in the capillaries. The only instance in which this is not the case is, when the inflammation is so intense that it leads to the arrest of tissue-change even before the circulation in the capillaries has completely ceased. This, however, soon follows, as the result of the alteration in the nutrition of the coats of the vessel from cellular infiltration ; so that, sooner or later, in a part which is becoming, or has become, gangrenous, there is complete stagnation in the capillary vessels, and arrest of the supply of nutritious fluids. The part therefore, of necessity, dies, is no longer capable of taking part in the functions of the living body, and becomes a foreign substance to which two things must happen. First, being no longer living, it must undergo a series of chemical changes, which result in decomposition; and secondly, being a foreign body and no longer capable of ministering to the necessities of the individual, it must be cast off and separated from the living tissues, thus forming what is termed 'a slough.' The death of a part is not always followed by the same series of changes. These will depend upon the presence of oxygen, and the amount of water in the tissues. For in the first place if oxygen be absent from the part, as in splenic infarction (which is a form of gangrene), no putrefaction can take place ; and secondly, when the tissues are much engorged, at the time of death, with blood and serum—when, in other words, there is the presence of water in large quantities—the moist form of gangrene will be the result, with rapid decomposition. When, on the other hand, the quantity of fluid, that is, water, in the tissues is small, the dry form of gangrene occurs, and the part undergoes a process of mummification, the difference existing rather in the clinical characters than in the anatomical changes. The putrefactive change consists in a solution of all the solids of the body, with the exception of the bones, in the fluids, because, in consequence of their death, they are no longer able to withstand the solvent power of such fluids. It is therefore a solution of the constituent elements of the body in water, and consists chemically in the decomposition of the various constituents of the body, and the recomposition of new products formed out of the elements with the addition of the oxygen of the atmosphere.

The gangrenous part, being dead and undergoing decomposition, becomes injurious to the living tissues, and must be cast off and separated from them. This is done by a process of ulceration, or molecular disintegration, in the living tissues which are in contact with the dead. The process of ulceration is a vital process, and can only be carried on in living tissues. Accordingly we find the vessels in the tissue forming the extreme boundary of the living part becoming enlarged and gorged with blood; migration of cells with proliferation takes place, so that the part is crowded with a dense layer of leucocytes. From these is formed a layer of granulation-tissue, by the growth of new vessels. The surface of these granulations—that is to say, the surface in contact with the dead tissue—softens and breaks down, the cells becoming converted into pus-cells, and thus the dead portion naturally falls off, because its adhesion to the living tissues has ceased to exist. This border line between the living and dead tissues, in which the process of separation of the one from the other takes place, is called 'the line of demarcation.'

After the dead parts are separated from the living, the surface of the latter is seen to be covered over with a layer of granulations, which eventually cicatrise and become converted into fibrous tissue.

Symptoms.—The symptoms of gangrene naturally form two great divisions, the one where the parts are swollen and moist—the so-called *moist gangrene*; and the other where they are dry and shrivelled—the *dry gangrene.* This division is a classical and, in extreme cases, a well-marked one, but, under ordinary circumstances, it is not easy to refer a case to one or the other class; the form of gangrene being often midway between the two extremes. Or, in a given case, we may have a gangrene partaking of the dry form in one part and the moist form in another. Thus in a case of mortification of the leg, it is not uncommon to find the toes and dorsum of the foot presenting the characteristic appearances of the dry or mummified form, while the calf of the leg, where the tissues are thicker, presents the typical characters of the moist variety of the disease.

MOIST GANGRENE may be best studied in a part which has been sufficiently strangulated to arrest the return of blood from the tissues. If the strangulation is more severe than this, so as to stop the flow of blood both from and to a part, as in the ligature of a pile or nævus, it kills the tissues outright. But if it is less severe, it prevents the flow of blood from the part, at the same time that it permits the entrance of blood to the part, the veins being more affected by the constricting force than the arteries. In consequence of this we get, first, a condition of intense congestion; blood continues to be propelled into the capillaries, from which it cannot escape. Hence, as the vessels become more and more loaded, the inflowing stream becomes slower and slower, until it eventually stops, the part being so overcharged with blood that no more can enter. This constitutes the second stage, for when complete stasis takes place gangrene is established. The third stage consists in decomposition, for after the gangrene has set in, decomposition commences, as has already been stated.

A line of demarcation is then established, and the mortified parts begin to separate at this point.

In considering the *symptoms* it is useful to divide them into three stages. *First stage,* congestion. The part becomes swollen, the swelling being at first hard and brawny, but after a short time pulpy and œdematous, as transudation through the coats of the vessels takes place. The colour, at first red, speedily becomes dusky and purplish and then almost black. There is a dull heavy burning pain in the part, with exalted sensibility, and the temperature is raised above its normal standard. Phlyctenulæ or vesicles arise on the surface, and become filled with a dark bloody fluid. *Second stage.* So soon as complete stasis takes place, the temperature begins to fall, and the thermometer soon registers a degree considerably below that of the rest of the body, and on a level with that of the surrounding media. Pain in the part ceases and it loses all its sensibility, so that the prick of a needle can no longer be felt. It changes its colour, becoming of a mottled greenish-black or purplish hue. *Third stage.* Decomposition now sets in, the part becomes very soft and boggy, and gives to the finger a sensation of emphysematous crackling, due to the evolution of gases in the tissues; a peculiar odour is also evolved from the formation of certain volatile compounds, such as sulphuretted hydrogen, ammonia, and hydro-sulphate of ammonia. At the same time a line of demarcation is established. At the point where the living join the dead tissues, a bright red band may be seen, gradually losing itself in the natural skin. This halo of redness is very different, and easily to be distinguished, by its brightness, from the dark and purplish hue of the gangrenous tissue. There is also generally some swelling. Shortly after a careful examination will reveal a slight furrow at the extreme margin of this inflamed tissue. The furrow deepens day by day, and increases somewhat in width, gradually undermining and separating the dead from the living tissues, the process being accompanied by a copious secretion of pus. The line of demarcation does not present a regular circular appearance, but a zigzag irregular outline, in consequence of the unequal distribution of the vessels. If a whole limb be mortified and cast off, the superficial tissues are separated at a much higher level than the deeper ones, and therefore the stump after this natural amputation presents a very conical form, from the centre of which the bone, which is only separated by an exceedingly slow process, protrudes.

DRY GANGRENE occurs when the whole supply of blood is entirely cut off and the part perishes from want of nutrition. It is best studied in those forms of gangrene in which the supply of blood to a limb is suddenly cut off by the blocking of the main artery by an embolus. In these cases there is a rapid cutting off of the arterial supply. The blood in the limb finds its way out by the veins which are unaffected, and hence there is less blood than natural in the part. Accordingly the part presents a shrunken or shrivelled appearance, and assumes a dull, tallowy-white colour, mottled here and there with brownish or greyish streaks. No pulsation in the vessels can be detected. The part feels dead and heavy, and at once entirely loses its sensibility. It feels cold to the touch and its temperature speedily falls, until it reaches that of the surrounding media. Very shortly the pale colour becomes lost, and the part becomes first brown and then black; it presents a more and more shrivelled appearance, and gradually dries up, as it were, so as to present the appearance of a mummy, and hence the name 'mummification,' which has been applied to this condition. The line of demarcation is set up and the process of separation continued as in the other variety.

The *constitutional symptoms* vary according to circumstances. When the constitution is sound and the gangrene is the result of some injury, the fever is of the ordinary inflammatory type, being characterised by a hot and dry skin, with a rise in the temperature of from 2° to 4° F., a full and quickened pulse, and a white and creamy fur on the tongue. But even in these cases there is a great tendency to asthenia, with depression of the powers of the system. If, on the other hand, the constitution is unsound, the symptoms are of an asthenic type from the first; a hot and burning skin, a considerable rise in the temperature, a feeble, very quick, and easily compressible pulse; a dry, furred tongue, with sordes; great depression of the nervous system, with anxiety of countenance and low, muttering delirium. The amount of constitutional disturbance in gangrene varies also with the situation and extent of the disease. If it affects a part which is of no great importance, as a finger or toe, and is limited in extent, and perhaps due to a local cause, the accompanying fever is very slight. When, on the other hand, it implicates an important organ or structure, as, for instance, a knuckle of intestine, the symptoms assume a grave and rapidly adynamic type.

Treatment.—As gangrene arises from numerous causes, it is clear that no one plan of treatment can be universally adopted. It will be convenient, nevertheless, to consider first the broad indications for treatment, and then pass in review the various modifications in our therapeutical and operative measures which will have to be resorted to, in reference, not only to the cause of the disease, but also to the constitutional condition of the patient.

The first point in the treatment of gangrene, and one of the highest importance, is, if possible, to remove the cause, and so arrest the gangrene. In some cases this, of course, cannot be done; but in others, where it is caused by the mechanical obstruction to the circulation of the blood in the part, the first thing the surgeon has to do is to get rid of this obstruction. Thus, gangrene, when threatening as a result of inflammatory processes producing tension, may often be averted by timely and free incisions into the inflamed and swollen tissues. So again, in hernia, by division of the stricture; in parts which have been too tightly bandaged, by the removal of the bandages; in paraphimosis, by freeing the prepuce; and in other cases, the surgeon may prevent a gangrene from supervening, and recovery may take place by restoring the circulation of the part, if the disease has not progressed so far as to have irreparably destroyed the tissues. In all cases where gangrene is imminent, an endeavour should be made, by maintaining the vital warmth of the part and encouraging and relieving the embarrassed circulation, to prevent its occurrence. This is best done by swathing the whole limb in a thick layer of medicated cotton-wool and applying loosely a flannel bandage. Hot water bottles may be placed in the bed, but not in contact with the part. The limb should be raised and the joints flexed; thus, in the lower extremity, the thigh should be bent slightly on the abdomen and the leg on the thigh, a position which will best facilitate the flow of blood through the larger vessels. If there is any appearance of venous congestion, the return of blood through the superficial veins may be accelerated by continuous and methodical friction in the course of the circulation, which will tend to keep these veins empty. Poultices, which are often employed in these cases, should be avoided. The endeavour of the surgeon should be to maintain an equable temperature; whereas the tendency of a poultice would be to produce a directly opposite effect, when first applied raising the part above the normal temperature, and subsequently, on cooling, depressing it below the ordinary heat of the body. After the gangrene is fully established and a line of demarcation set up, poultices—and especially charcoal poultices—are often extremely useful in hastening the separation of the dead parts.

After the gangrene has become fully established, our aim must be to control, as far as possible, the spread of the disease; to encourage the rapid separation of the sloughs; to support the powers of the patient, and to keep the parts as clean and free from odour as possible. At this time the question of amputation will present itself to the surgeon, and is one of vital importance. As a rule, in most cases it is safer to await the formation of a line of demarcation before undertaking the removal of a limb, but nevertheless there are exceptions to this general rule. In some forms of local gangrene, where, for instance, it is the result of some severe injury, and the whole limb has fallen into a condition of gangrene, either as the direct result of the injury or indirectly as the result of the subsequent inflammation, and the gangrene is clearly defined, it cannot be doubted that it is expedient to remove the part at once in order to relieve the patient of a great source of irritation, and of the depression of the vital powers which will of necessity ensue from the efforts made to rid the system of a spoiled part. So again, in gangrene from a ruptured artery or aneurism, amputation should at once be performed, inasmuch as the tissues are so infiltrated with blood poured out from the ruptured vessel or sac that there is no chance of the collateral circulation being carried on, or of the gangrene being arrested short of the seat of the injury. But in cases of mortification arising from ligature of an artery, or from an embolus plugging a large vessel, the proper course to pursue is to wait until a line of demarcation is set up, for it is impossible to say how much of the limb is dead or how far the gangrene may extend. Many forms of local gangrene do not require amputation at all; when it arises from a mechanical injury, and is *strictly limited* in its nature, no operative proceedings are required. So again, in the gangrene arising from the application of heat or cold, or from chemical agencies, it is better not to remove the destroyed parts, but to wait for the formation of a line of demarcation, unless, indeed, a hand or foot is completely dead, when immediate amputation may be necessary.

In gangrene arising from constitutional causes, there can be no question as to the propriety of delaying the amputation until not only a line of demarcation has been set up, but until it is well established and the ulceration has extended deeply into the tissues. In these cases it is impossible to say where the mortification may stop, and if amputation is performed it may not be done high enough, and the disease will recur in the stump; and, on the other hand, it may be done too high, and an unnecessary amount of limb be sacrificed. In these cases of constitutional gangrene, it must be borne in mind also that the tissues immediately above those which have fallen into gangrene are in a condition of greatly-diminished vitality, and therefore, if an operation be too hastily carried out, the disturbance set up by the amputation may occasion a recurrence of the mortification.

With regard to amputation after a line of demarcation is set up, there is some divergence of opinion, some surgeons preferring to allow the limb to separate of itself, others considering that its removal through, or just above, the line of separation is the preferable course. As a general rule, it would seem better to get rid of a large mass of decomposing tissue, which must create a very deleterious atmosphere, and expose the patient to the risk of purulent absorption; but to this rule there are exceptions.

If the surgeon has decided to save the limb, or if the gangrene is in some part inaccessible to operation, his endeavour must be to hasten the separation of the sloughs and diminish their fetor. This may be done by maintaining the heat of the part by wrapping the limb in cotton-wool well sprinkled with carbolate of lime, or animal charcoal powder. Poultices should not be applied if the amount of sloughing is great, since the moisture tends to promote decomposition; but if the sloughs are small, charcoal or yeast poultices may be used. The separation of the sloughs may be hastened also by the application of some of the balsams, of which the compound tincture of benzoin is the best. A most useful application for the same purpose is the 'green ointment' of the St. George's Hospital pharmacopœia:—℞. Unguenti elemi, lb. j.; Unguenti sambuci ℥ij.; Copaibæ ℥iij.

The ointments to be melted together, and, when cooling, the copaiba to be added. Ung. sambuci is made with the *fresh* leaves of the elder (lb. ij.), prepared lard (lb. ij.), and as much water as required.

The constitutional treatment consists in supporting the powers of the patient and lessening the irritability of the nervous system. It must be borne in mind that the disease in itself indicates a depressed condition of the system, and therefore the endeavour of the surgeon should be to maintain the patient's strength by easily-digested nutritious food, stimulants, and tonics, and to improve, if possible, the digestion, by clearing out the alimentary canal, so as to enable him to take the requisite amount of nourishment. The food and stimulant must, however, be given with a discriminating hand, great care being taken not to overload the patient's stomach; just so much of bland, nutritious food and stimulant as he can easily digest should be given in small quantities and frequently. In most cases the issue of a case of gangrene depends upon the digestive organs effectively and efficiently performing their duties. Should they become overworked, sickness and vomiting, with loathing and refusal of food, will come on and the patient will rapidly sink. At the same time pain should be allayed and the general system soothed by the administration of opium, or some other narcotic. There are few cases of gangrene in which a narcotic is not required, and of these opium is decidedly the best. Should it, however, cause excitement, or loathing of food, some other must be substituted, as morphia injected under the skin, or cannabis indica, which is often tolerated when opium cannot be borne.

It remains now only to say a word or two upon the treatment of some special forms of gangrene. And, first, as to the treatment of senile gangrene. Here the plan to be adopted, as far as regards the constitutional treatment, is much the same as in other forms, opium being especially indicated and usually well borne. At the same time stimulants must be given with care. A small quantity is no doubt usually necessary; but, given in large quantities, so as unduly to excite the patient and increase the action of the heart in its endeavours to drive the blood through the calcified and narrowed vessels, they do more harm than good. The main point for consideration is the question of removal of the dead parts after a line of demarcation has been set up, and this may be done either by amputation just above the line of separation, or by removing the limb high up in the thigh, a plan formerly advocated by James, of Exeter, and more recently adopted in several cases by Hutchinson. As a rule, the former operation is to be deprecated, gangrene often recurring in the stump, and secondary hæmorrhage, from the diseased condition of the vessels being of frequent occurrence. The latter operation is also a very serious alternative, and unless the general health is otherwise good and the constitution tolerably sound, appears to be scarcely justifiable. The better plan in these cases seems to be to allow the soft parts to separate by nature, and then carefully to cut through the hard parts along the line of demarcation.

The question of amputation in another form of gangrene demands attention, and that is in the spreading traumatic gangrene of inflammatory origin. In these cases there is, as has been pointed out, no tendency to the arrest of the gangrene and the formation of a line of demarcation. The morbid process rapidly extends to the trunk and speedily kills the patient. In these cases, feeble as is the chance, amputation is the only hope of saving the life of the patient, and should be adopted at once. There is no time for delay; so soon as traumatic gangrene begins to spread, amputation should at once be performed through healthy parts, and a certain proportion of cases will recover. T. Pickering Pick.

GASTRIC FISTULA.—A communication between the stomach and the external air. It necessarily implies adhesion between the peritoneal surfaces of the stomach and the anterior abdominal parietes. The object of the operation of gastrostomy is the safe production of such a fistula. But it is occasionally produced by accidental causes; for example, by gunshot wounds, where a portion of the anterior abdominal parietes and wall of the stomach have been carried away, as in the well-known case of Alexis St. Martin. Another class of cases in which these fistulæ may be produced is where the patient has swallowed hard, irritating material which cannot pass through the pylorus. Thus knives, and other iron instruments, have occasionally given rise to the formation of such a fistula. The way in which they do so is this: first such a body becomes impacted in a certain position, usually from before backwards, in the stomach. The constant pressure gives rise to some severe local peritonitis between the front wall of the stomach and the anterior abdominal wall, and the two adhere. Ulceration then supervenes from the same cause, and gradually affects the opposing thickness of stomach-wall and wall of abdomen, so that finally the foreign body presents at an abdominal wound, and may be removed at that point. The aperture so left is the gastric fistula in question.

No particular treatment is required for such a case, except to prevent leakage of the gastric juice from it. A gastric fistula may nearly always be recognised by the acid, irritating quality of the secretion flowing from it, by the absence of bile-staining, and by the kind of food escaping from it. If it should be desired to cure it, this can nearly always be done by a plastic operation—paring the edges and bringing them closely together by sutures. The same is true of a gastric fistula produced by a gastrostomy. H. G. Howse.

GASTROSTOMY.—The operation of making a fistulous opening into the stomach from the anterior abdominal parietes, for the sake of feeding a patient, when, from any cause, the natural passage down the œsophagus is obstructed. The word is derived from γαστὴρ, belly, στόμα, mouth, —the 'belly-mouth,' hence not to be confounded with gastrotomy, which is simply cutting into the abdomen for tumour or any other affection.

The operation is most frequently performed for cancerous or syphilitic strictures of the gullet, but it has been also done for simple inflammatory stricture or ulceration, as when the gullet has been nearly destroyed by the patient swallowing caustics by accident or for suicidal purposes. Up to quite recently the operation had been nearly always attended with fatal results; but, by a modification introduced by the writer of the present article a few years ago, the operation is now only attended with a very small mortality, and even this is mostly attributable to the late period at which the operation is done, and the consequent exhaustion (from starvation) of the patient. The modification alluded to consists in securing adhesion of the stomach to the abdominal walls before opening the viscus itself, this part of the operation being delayed for periods varying from three to five days.

The steps of the operation are:—(1) making an oblique incision about two and a half inches long, parallel with, and about one inch below, the lower margin of the costal cartilages forming the lower boundary of the thorax on the left side. This incision should start about one and a half inches from the median line, and its length must depend upon the varying development of the rectus muscle. It is not wise to go higher than this, as it will not leave enough free integument and muscle between the cartilages and the incision to fasten the sutures to. This first incision is only to be carried through the integuments and fascia. When made, the sheath of the rectus will be seen at its inner end, and at its outer end a portion of the linea semilunaris and of the obliquus externus muscle. The usual plan of continuing the operation is to have the muscle and fascia of the abdomen incised in the same way as the superficial parts. The writer has, however, found it more advantageous to continue the operation in the following way:—(2) The lips of the wound being separated towards the inner part as widely as possible by retractors, a *vertical* incision is made in the sheath of the rectus a little way from its outer margin. The vertical fibres of the rectus will then be seen, and these should be separated (not cut) with the handle of the scalpel, and the posterior part of the sheath exposed. This may then be incised vertically, together with the sub-peritoneal fat and peritoneum. (3) The search for the stomach will now commence. Very possibly it may protrude into the wound, but it may be altogether hidden under the ribs, or the liver may be enlarged, and be the only viscus at first visible when the peritoneal cavity is opened. If the liver presents it may be easily pushed aside, though the position of this viscus may afterwards interfere inconveniently with the adjustment of the sutures. The principal difficulty is with the great omentum and transverse colon, which may be easily confounded with the stomach. If one of these presents in the wound, it is best to catch hold of it and draw it down. In this way the stomach may be brought into view. It is recognised by its pink-red, smooth, thick coat, quite unlike that of the transverse colon.

(4) The stomach has now to be fixed to the abdominal parietes. This is usually done with a double row of sutures. For this the writer commonly uses moderately thick, smooth carbolised silk. Drawing the stomach well over to one side, a needle (in handle) carrying the silk should be passed through the serous and muscular coats of the stomach only, and should then transfix the abdominal parietes about one inch from the wound. The needle is now withdrawn, leaving one end of the silk on the surface,

and without unthreading the other end the abdominal parietes are again punctured alone. The silk is now unthreaded from the eye of the needle and the latter withdrawn. The two ends of silk will thus be left projecting from two distinct wounds on the skin close by one another, and holding up a bit of the serous and muscular coats of the stomach. These ends may ultimately be tied over a bit of bougie, the aim being to secure isolated points of attachment between the two layers of peritoneum by interrupted sutures. Before tying any one suture, it is best to introduce the others, drawing the stomach well over from the side towards which it is wished to introduce the suture. Six or eight sutures introduced in this fashion are usually used. The result is to fix the gastric peritoneum in a circle about one inch round the wound. The part of the stomach exposed in the wound should then be fixed to the lips of the incision by small wire sutures, introduced by a small curved needle held in a needle-holder, these again only taking up the serous and muscular coats of the stomach. Finally it is best to *mark* the point at which it is desired to puncture the stomach ultimately, by fixing to it a moderately long, loose suture, which may easily be recognised from the others. The operation should be conducted with Listerian precautions, and, of course, under an anæsthetic.

Five days is the usual time the writer has left the stomach in this way for complete adhesion to form. The opening of the stomach is a very minor affair, and does not require any anæsthetic. The patient never complains of pain and, in the writer's experience, generally does not even know when the puncture is actually made. A long narrow-bladed pointed knife is usually employed, such as is used for paring the edges of a vesico-vaginal fistula. The knife should be very sharp, and be driven straight into the stomach in the position of the mark left at the first operation. The cavity of the stomach often apparently lies much deeper than would be expected, and makes the operator sometimes fear he has punctured the lesser bag of the peritoneum. A small catheter (No. 7 or 8 English) should then be slid along the blade of the knife, which may be withdrawn. For ascertaining whether this is in the stomach-cavity, sucking at the tube is often a useful though not a pleasant mode of testing; but in these cases of starvation there is usually very little to draw out through the tube. Small quantities of milk and brandy may immediately be injected along the catheter, but the quantity should be very moderate at first, beginning only by teaspoonfuls, and increasing afterwards. A bit of elastic tube being adjusted over the catheter and plugged, the wound should again be dressed antiseptically, leaving the end of the tube projecting through a mass of surrounding gauze.

At subsequent dressings larger sizes of catheter may be substituted for the No. 8, and, finally, soft red rubber tubes introduced up to any convenient size. The patient should first be fed with fluid food, such as milk and beef-tea, &c. But when the larger sizes of tube have been introduced, solid food may be poured into the stomach by the aid of a large wide-mouthed syringe, This food should be minced meat with a certain proportion of vegetables, all finely ground in the mincing-machine.

Many other details must of necessity be omitted in a short article like the present; but it may be remarked, in conclusion, that the object of the vertical incision through the rectus muscle, and of the small incision, and subsequent gradual dilatation, of the stomach, is to obtain a kind of sphincter action around the tube, so as to prevent the leaking of the gastric juice, which is so unpleasant a feature in some of these cases. The vertical separation, without cutting, of the fibres of the rectus muscle, and the puncture and subsequent dilatation of the muscular coat of the stomach, conduce to this end more effectually than any other method. H. G. Howse.

GASTROTOMY. *See* Laparotomy.

GAUZE DRESSING. *See* Antiseptic Surgery.

GENU EXTRORSUM is something more than Bow-Leg (q. v.), which is simply an outward bending of the leg-bones; in genu extrorsum the thigh-bone is bowed outwards as well as the leg-bones, so that the knees are widely separated. As opposed to the inward deviation of knock-knee, genu extrorsum is sometimes spoken of as 'out-knee.' The condition is met with in heavy, weakly, or rachitic children, in whom the bones are less able to support the weight than are the ligaments. When the ligaments are the first to yield, genu valgum appears, but when the bones are feeble, genu extrorsum is induced. With the strong support of the ilio-tibial band, the external lateral ligaments of the knee-joint are competent to resist any strain that may be brought to bear upon them, whilst from the natural obliquity of the femur, the chief strain falls upon the inner side of the joint. The bending of the bones of the thigh and leg is not associated with notable alteration in the shape of the femoral condyles, as is the case in genu valgum.

Many of the remarks made in connection with the subject of Bow-Leg will apply in the treatment of genu extrorsum; but as the knee-joint is displaced to the outer side of the normal line, it would be incorrect to bandage the limb to the outer side of a long splint; the effect of this treatment would be to throw a useless strain upon the internal lateral ligament, which is in no way at fault. Indeed, in all attempts at the forcible straightening of the limb, this ligament must be respected. Though forcible straightening is of value in the treatment of these limbs in early childhood, it is as a rule unnecessary; for if the child be kept entirely off his feet, and well looked after, he will most probably outgrow his deformity. A strict and prolonged supervision gives excellent and surprising results. The expensive mechanical supports of the makers of surgical apparatus are of little service; whilst to allow a weak-boned child to walk about in 'irons' is a violation of all sound principles of practice. What is required is absolute rest in childhood; but when the bones are fully developed, as in young adults, nothing short of osteotomy can remedy the deformity. *See* Osteotomy. Edmund Owen.

GENU VALGUM or KNOCK-KNEE is a common deformity of childhood, and, unless corrected, is apt to persist in even a more marked form in adult life. To leave this disfigurement unattended to, and to promise the parents that the child will certainly 'grow out of it,' is to court disappointment. It is generally associated with, if not determined by, a relaxation of the ligaments of the ankle and sole of the foot, the knock-kneed subject being generally flat-footed. The tibia having lost much of its support at the inner ankle, the upper surface of its head receives the weight unevenly from the two femoral condyles, the outer tuberosity getting more than its due share. This extra pressure causes some arrest of growth of the external condyle of the femur, whilst under the diminished pressure the internal condyle grows inordinately; in some instances it is at the internal tuberosity of the tibia that the growth of bone takes place, in which case there will be considerable bony thickening at the inner side of the epiphysial cartilage. When growing lads are called upon to do an excessive amount of walking or standing, or when they follow employments which involve much weight-carrying, the deformity is apt to supervene. Thus bakers are particularly apt to become in-kneed. In young children the most common cause is malnutrition; it is especially apt to be found in those who have been brought up by hand, and who have been surrounded generally by a defective hygiene. In the writer's experience, children who have been reared on condensed milk and a farinaceous diet are likely subjects of knock-knee. These rickety children have generally a heavy trunk and a large head, which the ill-developed legs and feet are unable properly to support, and if the ligaments yield rather than the bones, flat feet and knock-knees are the result. When once started, the deformity increases rapidly.

Probably heredity has but little direct influence on the condition, though parents of feeble constitution, themselves valgous, are likely to have weak-kneed offspring. In estimating the amount of the deformity, the leg should be fully extended, so that the lateral ligaments of the joint (which are behind its vertical axis) may be rendered tense, and the tibia rigidly locked upon the femur. If the least amount of flexion be permitted, the valgous condition may be completely effaced. When the patient is lying supine, the patellæ should be made to look directly upwards; these bones are displaced considerably outwards on account of the deflected course which the rectus femoris has been made to take in the valgous knee. At times one limb is found valgous whilst the other is bandy, as is explained under Bow-Leg.

Treatment.—In the early days of genu valgum, the treatment will involve care in the matter of clothing and diet. The child should be taken completely off his feet, and the mother or nurse should rub the legs and feet well, in front of the fire, and should see that the circulation in them is always active. She must be instructed also in trying to straighten the extended limb by judicious, firm, and repeated efforts, five or six times a day. From time to time also the surgeon should manipulate the limb. If only one limb be affected, a well-padded outside splint may be applied to the limb, firmly strapped or bandaged to it. If both knees be valgous, a firm, flat pillow may be fixed between the knees and the ankles tied together. On no account should the child be allowed to stand or walk. If the treatment prove slow or unpromising, the surgeon may attempt the straightening of the limb, under chloroform, by forcible manipulation.

In many cases this treatment answers well. After the straightening, the limb may be fixed in lateral splints of plaster of Paris, or the straightening may be effected more gradually by a hinged splint, working with a rack and pinion. But in those cases in which, from one cause or another, this treatment cannot be employed, or in which, being tried, it proves ineffectual, osteotomy may be resorted to with advantage. *See* Osteotomy. Edmund Owen.

GIBSON'S SPLINT FOR FRACTURED THIGH consists of two long splints, with a crutch for the axilla at the upper end of each; the lower end of each splint is perforated by a series of holes for pegs, and fits into a slot in a footboard. Counter-extension is maintained by the pressure of the crutches against the axillæ, and extension is made by pulling on the footboard, to which the feet have been fixed; when sufficient extension has been made, the footboard is prevented from slipping back by pegs placed in the proper holes in the splint. Bilton Pollard.

GINGIVITIS. *See* Gums, Affections of.

GLANDERS (*Synon.* Equinia; Farcy) is an inflammatory affection of the nasal mucous membrane, to which horses, mules, and asses are liable; and it is occasionally communicated to those who tend them by accidental inoculation, or by absorption of the specific contagion through the unbroken skin or mucous membrane. Farcy is the name given to a peculiar inflammation of the subcutaneous lymphatic vessels and glands, accompanied by the formation of hard swellings which break down into foul ulcers. Both these affections are manifestations of the same specific disease, and it is probable that their differences are determined by the mode in which the contagion is received. In man, as in animals, the disease may run an acute or chronic course.

Course and Symptoms.—After an incubation of three to eight days in the more acute forms, but extending to several weeks in more chronic cases, the onset of the disease is marked by languor and feverishness, pains in the joints and muscles, and chilliness or even rigors. The wound by which the virus has entered, although it may have healed, becomes inflamed, and a chancroid ulcer forms, with red, swollen, and very tender margins. In other cases, however, there is no such evidence of the seat of inoculation. The characteristic features of the disease soon appear in the form of (1) hard swellings under the skin and in the muscles; (2) a cutaneous eruption; and (3) an ulcerative inflammation of the mucous membrane of the nose.

1. To the pains in various parts of the body succeed diffused or circumscribed elevations in the subcutaneous or muscular tissues. They are hard, tender, and very painful, and they soon break down into foul, deeply excavated ulcers. Some, however, after a time, undergo resolution and disappear. At the same time a corded state of the lymphatics may be observed, not only near the seat of inoculation but in other regions, and this is accompanied by glandular swellings similar to the 'farcy-buds' which occur in the horse.

2. A peculiar skin-eruption appears somewhat later. At first papular or even tubercular, it soon develops into pustules or blebs containing sero-purulent material. These are scattered in irregular groups over the surface, and especially over the face, chest, and abdomen. Sometimes they are very hard, and slowly soften, resembling small boils; at other times they form flattened, irregularly-shaped vesicles or bullæ of various sizes, surrounded by a livid erythematous swelling of the integuments, and they are succeeded by foul, superficial ulcers.

3. Usually the latest, but occasionally the first, symptom is an inflammation of the nasal mucous membrane. A thin, clear discharge like that from an ordinary coryza is noticed. Soon this becomes viscid, sanious, and offensive. The mucous membrane swells, and patches of ulceration form, with foul crusts upon them. The skin of the nose and of the adjacent parts of the cheeks and forehead becomes red, tense, and swollen, and glandular enlargements appear in the parotid and submaxillary regions. The inflammation may also extend to the frontal sinuses, the tonsils, and the air-passages, and the eyelids may be glued together by a similar discharge from the inflamed conjunctivæ.

The constitutional symptoms, meanwhile, tend to assume a typhoid character. Muscular tremors, muttering delirium, sour sweats, and diarrhœa supervene. In the most acute forms the patient may die exhausted in three or four days, even before the third stage has been reached. Few survive for more than three or four weeks, and in the more chronic cases it is usually many months before the abscesses heal and the patient recovers.

Pathology.—According to Virchow, the nasal affection and the cutaneous eruption are both due to the formation, in the substance of the corium, of tubercular masses, which caseate and then soften down into suppurating foci. The larger nodules in the subcutaneous and deeper tissues are due to similar deposits of caseous material which degenerate into hæmorrhagic abscesses. After death the blood is usually found to be fluid, the muscles soft and rotten, and there are changes in the viscera which bear a close resemblance to those found in pyæmia.

The *diagnosis* is at first obscure. The fever and vague pains may be confounded with rheumatism, and when the swellings have appeared it may be difficult to distinguish the acute form from pyæmia, and the more chronic form from tertiary syphilis or scrofula. The patient's antecedents will probably give some clue, and the diagnosis will soon be confirmed by the appearance of the eruption. This has been mistaken for varicella and smallpox, and, later on, for ecthyma and pemphigus; but the fact that it is associated with hard or suppurating subcutaneous swellings ought to suffice for its recognition. The acute character of the nasal affection, together with its concomitants, will distinguish it from the various forms of ozæna.

Treatment.—It will be necessary to support the patient by a liberal diet with alcoholic stimulants. Quinine in five to ten-grain doses should be given three times a day. Other aseptic remedies, such as sulphite of sodium, deserve a trial. Mineral acids, perchloride of iron, and other tonics, will be useful in the more chronic cases, and opium will be required to alleviate the severe muscular pains, as well as to induce a more healthy action in the local inflammations.

The original seat of inoculation, as soon as there is reason to suspect its dangerous character, should be cauterised with nitric acid or potassa fusa. The abscesses should be freely incised, and their cavities well washed out with carbolic acid, and dusted over with iodoform powder. Similar applications must be used for dressing the superficial ulcers. The nose must be repeatedly syringed with antiseptic solutions, and the patient should be directed to inhale frequently vapour charged with iodine, creasote, or carbolic acid.

Equinia Mitis is a milder disease, consisting of an eruption of pustules and bullæ, which sometimes attacks the hands of those who have to dress the heels of horses affected with 'the grease.' It appears to have no relation to glanders, and its treatment will be cleanliness, with the application of liquor plumbi subacetatis dilutus, or a weak solution of carbolic acid.

N. Davies-Colley.

GLANDS, LYMPHATIC, Affections of. *See* Lymphadenoma, &c.

GLAUCOMA, in its most general acceptance, signifies all those conditions in which the eyeball is unduly hard. But it is necessary, for the proper study of its pathology and treatment, to separate the cases of primary glaucoma from those in which the hardness is merely secondary to some other recent morbid condition—e.g. iritis, intra-ocular tumour, &c. The subject of secondary glaucoma will be separately discussed later.

The hardness of primary glaucoma may be permanent or but temporary, recurring from time to time. Such temporary cases pass ultimately, if unchecked, into the permanent condition. They are known by the name of intermittent glaucoma.

Though numerous and most ingenious instruments called 'tonometers' have been constructed, yet the tension of the globe is now universally estimated by the finger of the surgeon. The eye, while open, and directed gently downward, is felt through the upper lid by the two index fingers. The estimation is made by the amount of dimpling effected by slight alternate pressure of the fingers, or by the feeling of resistance imparted to the touch. In any case the standard is a purely arbitrary one, and consequently varies with different observers, and even with the same observer at different periods. The other eye of the patient, if sound, will afford some guide. Three degrees of increased or diminished tension are usually recognised, the first being represented by T_1, T_2, and T_3, and the last by $-T_1$, $-T_2$, and $-T_3$. Between the two series stands normal tension, Tn. T ? expresses a doubt whether there is any deviation from the normal; but T_1? or $-T_1$? accepts the increased or diminished tension, but is uncertain as to its degree.

Glaucoma is comparatively a rare disease, being met with in one out of about two hundred and fifty cases of eye-disease. Four-fifths of the sufferers are over forty years of age. It affects the sexes in not very unequal proportion, though the statistics of various authors make it a little more common among males.

Briefly speaking, the diagnostic symptoms of a primary glaucoma are, *in the premonitory stage*, unduly failing accommoda tion, frequently repeated attacks of foggy vision, and halos; *later*, hardness of the eye, with, in all probability, cupping of the optic papilla or disc and contraction of the field of vision. *See* PERIMETRY.

Primary glaucoma is usually divided, for clinical purposes, into two groups—the non-inflammatory and the inflammatory.

The *non-inflammatory* is the one more commonly encountered, especially among men, where, according to Nettleship, it constitutes 75 per cent. of all the cases; whereas in women it forms but 52 per cent.

A typical case of non-inflammatory glaucoma would be as follows:—The patient, who may well be a man of from fifty to sixty years of age, makes complaint of long-standing occasional aching in the eyes and difficulty in reading. He has changed his reading spectacles several times recently without much benefit. It is found that he is more presbyopic than usual at his time of life, even when allowance is made for the hypermetropia which he usually exhibits. For some time he has had occasional attacks of foggy vision, with coloured rings or halos round an artificial light. The pupil is sluggish; the anterior chamber rather inclined to be shallow, but the cornea fairly bright. Light thrown into the eye by the mirror alone shows the lens and other media to be perfectly transparent. While there is some general impairment of sight, the defect is far greater at the peripheral portions of the field of vision, especially at the inner or nasal part, so that fingers, or, better, a white spot, cannot be perceived till nearer the point of central vision than normal. The ophthalmoscope shows the optic disc to be excavated so as to form a cup narrowed at its mouth. Its base—white, with a bluish tinge—shows greyish mottlings corresponding to the pores of the lamina cribrosa. Its vessels, only slightly diminished in size, are visible where they emerge at the bottom of the cup and as they wind round its overhanging edge; but between these two points they lie along its hollowed-out sides, and so are hid from view. The disc may be fringed by a pale ring of atrophied choroid. Closer examination by the erect image shows a pulsation not only of the veins, but also of the arteries; or this latter sign, if wanting, may be produced by slight pressure of the finger on the globe. The eye is distinctly harder than normal, though not excessively so. No outward signs of inflammation or vascular congestion are present.

An *inflammatory* glaucoma in its more acute form (glaucoma acutum) presents changes for the most part similar. But its onset has been more sudden, unless, indeed, it has supervened upon a glaucoma simplex, and is frequently marked by neuralgic pain in the eye or round the orbit, or possibly by vomiting. There is lacrymation, with great vascular congestion, both ciliary and conjunctival, and possibly even swelling of the upper lid. The anterior ciliary arteries are decidedly larger and more tortuous than normal, and their very superficially placed communicating vessels are also large. The iris is dull and discoloured, and the dilated inactive pupil not infrequently oval in a vertical direction. The anterior chamber is markedly shallow, and the cornea steamy. The lens, though transparent, has a smoky appearance. Ophthalmoscopic examination is difficult, and sometimes impracticable, from corneal and vitreous haze. Cupping of the disc is not so constant or so well-developed as in glaucoma simplex on account of the less average duration of the disease; indeed, it may be entirely wanting, and the disc be simply red, with large and apparently numerous pulsating vessels; or it may be indistinguishable on account of opacities in the media, as above mentioned. Limitations of the visual field are not so striking or so easily detected as in glaucoma simplex, a condition dependent to some extent on the more marked general impairment of sight. The eye is decidedly hard (T2 or T3).

Inflammatory glaucoma is usually subdivided, for clinical purposes, into two forms—glaucoma acutum and glaucoma chronicum.

Very rarely it happens that an inflammatory glaucoma is so rapid and severe as to reduce the vision to perception of light, or even destroy it altogether within a very short time—perhaps only twenty-four hours. To this variety of acute inflammatory glaucoma the name of *glaucoma fulminans* is applied.

Sometimes the glaucomatous outbreak is preceded by the appearance of numerous small retinal hæmorrhages. To such cases the name of *glaucoma hæmorrhagicum* is given. This group is important in a clinical sense, as this form of the disease is little amenable to ordinary operative treatment. Still more rarely glaucoma is preceded by swelling of the optic disc. It is questionable, however, whether the disease can then be ranked as a primary glaucoma at all. The same remark applies to hæmorrhagic glaucoma. Glaucoma, in whatever form, has its later stages characterised by still diminishing sight, both central and peripheral, by increasing whiteness of the floor of the cup.

and by diminishing size of the retinal vessels. The widely dilated pupil may be reduced to a mere rim. The cornea becomes quite anæsthesic, but there may be occasional attacks of severe neuralgic pain both in and around the orbit. Minute retinal hæmorrhages are not uncommon, but they may be obscured by the development of the cataractous condition. In cases of long standing there may be corneal opacities of inflammatory origin, which are apt to take the form of a superficial, horizontally-running, transverse band.

Any case of primary glaucoma which has so far progressed as to be hopeless, passes by the name of *glaucoma absolutum.*

Cases are also not infrequently observed where, though all the other usual symptoms of glaucoma simplex are present, inclusive of the cupped disc, no increase of tension is perceptible to the finger. In such we may accept the arterial pulsation and the usually well-marked cup as indicative of some long-continued increase of pressure, too slight for appreciation by our ordinary methods, or we may find a definite history of occasional outbursts of tension (glaucoma intermittens).

Glaucoma, though rare, is not wanting in children and young adults. In such cases the sclerotic yields gradually to the pressure, the change being more noticeable in the anterior half of the eye, especially in the cornea. The disease has consequently passed under the name of 'buphthalmos' or 'hydrophthalmos.' But the more numerous cases where this condition is secondary to iritis in infancy, or, more commonly, in intra-uterine life, should be carefully distinguished from those in which the buphthalmos indicates primary glaucoma occurring in young subjects.

It is clear that opportunities of examining early and slight cases of glaucoma must be, of necessity, rare in the extreme. But the pathological changes of advanced glaucoma are well-determined, though authorities are by no means agreed as to the precise significance of each and their relative order. Taking, therefore, a chronic inflammatory glaucoma which has attained the absolute stage, the globe is of about normal size and the conjunctiva extremely thin. Small bluish-black areas often mark the existence of local thinnings of the sclerotic. Two such—at the outer and inner equators respectively—are of common occurrence. They correspond to the terminal part of the course of the long ciliary arteries and nerves within the substance of the sclerotic, and are correspondingly elongated in form from before backwards. The nerves themselves are usually of large size, as are also the accompanying arteries. The optic nerve is smaller in section as well as more firm and unyielding than normal, though its mouth is somewhat widened from a yielding of the fibres of the lamina cribrosa. The globe, when divided across its equator, stands up well against the knife, on account of the firmness and full size which the vitreous body usually presents. The iris is advanced, so that its widely-dilated pupillary margin no longer rests upon the lens, and its excessively atrophied peripheral part firmly adheres to the corresponding anterior, or rather outer wall, of the anterior aqueous chamber. The rest of it is also much atrophied, apparently from long-standing inflammation, of moderate severity though of low type. Its anterior surface is shortened, so that the uveal pigment, rolled forward into view, lines the pupillary margin with black. The ciliary body and the iris have their afferent arteries enlarged and patent. The shrinking of the ciliary body may be such as ultimately to reduce it to half its original thickness. This change is associated with the formation of more or less connective tissue between its much-atrophied muscular fibres, the product of a low form of inflammation, as in the iris. The pigment epithelium of both iris and ciliary body remains unaltered. The ciliary folds are commonly much shrunken. The optic disc may be encircled by a narrow zone of atrophy, but otherwise the choroid is normal. The retina is also normal in structure, except for some atrophy of its nerve-cell and nerve-fibre layers, and a diminution in the size of its arteries and veins. The walls of both arteries and capillaries are hyaline and rigid, and aneurismal dilatations of the latter are not uncommon. The retina is commonly cystic where it borders upon the ora serrata.

The connective-tissue framework of the optic nerve is much thickened and very irregular. It supports many large blood-vessels, and encroaches very much upon the nerve-bundles, which, like the trabeculæ, show a very marked hypernucleation. The cupped and atrophied disc may be lined by imperfectly formed non-vascular fibrous tissue. The vitreous is usually slightly yellowish in tinge; it is comparatively easy to find cell-elements in it. The canal which traverses it—the canal of Cloquet—may be found enlarged, especially at its posterior part. The lens is usually of average size, except when it is cataractous, in which case it is for the most part somewhat diminished.

Some few cases, however, occur where it is large, soft, and globular—the result, in all probability, of an early stage in the formation of cataract, similar to that sometimes also encountered in eyes with normal tension.

The exact condition of things in the earlier stage of glaucoma may be inferred from the comparatively few examinations that have been made, and from the ophthalmoscopical and clinical appearances. It is certain that the lens and iris-base are at first free from the cornea, but that they afterwards become advanced by pressure from behind in the course of development of the disease. The writer is also satisfied that the inflammation and atrophy of both iris and ciliary body are also consequences of the increased pressure. Both are, in all probability, the direct result of the application and resulting inflammatory adhesion of the iris-periphery to the cornea. The changes affecting the optic disc, as well as those within the optic nerve itself, are also secondary to the increased pressure within the vitreous chamber. Some uncertainty exists as to the state of the ciliary folds. It is maintained by some that they are congested and consequently enlarged in the earlier stages of glaucoma. Such a condition is not improbable in view of the supposition of an increased flow of fluid into the eye, though the evidence at present before us is not sufficient to establish it.

The pathological differences in the various forms of glaucoma relate to the period and degree of development of inflammatory symptoms, these being entirely wanting, so far as external appearances are concerned, in glaucoma simplex (at all events, in all but its later stages), whereas they are observable in inflammatory glaucoma from its very outbreak.

The original development of a primary glaucoma is due to a disturbance in the balance of the intra-ocular fluid, to the origin and course of which it is consequently necessary to devote a short space. According to common acceptance it is secreted mainly by the pigment-epithelium of the ciliary folds, and to a less degree by that of the ciliary body generally and posterior iris-surface. From the ciliary body it passes centripetally—some into the posterior aqueous chamber, some into the adjacent lens-margin, but most into the vitreous chamber, where it tends to accumulate in the canal of Cloquet. From these various parts it passes forwards by way of the pupil to the extreme peripheral part of the anterior aqueous chamber, where it filters through the epithelioid cells of the meshwork of the ligamentum pectinatum into the canal of Schlemm, whence it gains the episcleral veins. That portion coming from the vitreous chamber has passed round the lens margin, either between it and the ciliary folds, or along the grooves between the latter, into the posterior aqueous chamber, and so on through the pupil as above described. An obstruction to this flow at any point of its forward course, or a secretion of the fluid in larger quantity than can traverse the normal outlets, will constitute a glaucoma.

There is strong evidence that the fifth nerve determines the amount of secretion into the eyeball. Experimental irritation of this nerve has caused the tension to rise, and glaucomatous attacks are often ushered in by neuralgia of one or more of its branches, though we must not forget, on the other hand, that trigeminal neuralgia is far more commonly unaccompanied by any change in the tension. Paralysis of the fifth is sometimes associated with distinct slackness of the eyeball, and the same result is favoured by stretching the supra-trochlear branch of this nerve. It is likely that, as the tension of the eyeball has been found to bear a distinct relation to the blood-pressure, the influence of the fifth may be exerted through its connection with the sympathetic.

The phenomena of intermittent glaucoma, of sudden outbreaks of tension, especially when preceded or accompanied by neuralgia of the fifth nerve or much lacrymation, of increased or diminished tension following a blow without apparent structural change, are all totally irreconcilable with the production of glaucoma by obstruction. Moreover the action of eserine, which by contracting the sphincter muscle of the iris and thereby opening more widely the meshwork of the ligamentum pectinatum, does in certain cases reduce the tension to normal, shows that the fault lies neither in closure of the outlets, which are really capable under the influence of this drug of transmitting a far larger quantity of fluid than normal, nor in the nature of the fluid itself.

Therefore the writer adheres most unreservedly to the view first enunciated by Donders, that the original cause of a primary glaucoma is an undue secretion into the eyeball. But, at a more advanced stage of the disease, obstruction to the normal outflow at the ligamentum pectinatum is superadded, this being a direct mechanical result of the previously existing hypersecretion.

The various pathological changes of glaucoma are perfectly explicable on the hypothesis of an increased secretion followed by a secondarily produced obstruction. The accumulation of fluid within the substance of the vitreous itself and in its central canal thrusts forwards the lens and ciliary folds, and with them the adjacent iris-base. If the quantity be large, as in the inflammatory forms of glaucoma, the iris-base becomes actually applied to the meshwork of the ligamentum pectinatum, thereby effectually blocking it. The same result is favoured, both here and in the later stages of glaucoma simplex, by paralysis of the muscular fibres of the iris from pressure in the course of their afferent nerves. The iris-base becomes inflamed, and subsequently atrophied, in consequence of its compression. The same changes extend to the rest of the iris and to the adjacent muscular fibres of the ciliary body.

There has been much discussion as to the exact means by which the iris-base is advanced. Though it is now certain that the anterior extremities of the ciliary folds are the immediate propelling agents, yet the difficulty is thus merely removed one stage backwards. Some have said that the folds are so much swollen in glaucoma as to press upon the iris. But swelling of the ciliary folds is at least as well established in many diseases, with normal tension and no advance of the iris, as in the early stage of glaucoma. Nor would this supposition account for the advance of the lens, unless indeed it were maintained (as has been done) that the swollen folds and the lens together form a diaphragm impermeable to the proper passage of fluid from the vitreous chamber. But the iris-periphery is as readily advanced after the extraction or dislocation of the lens as when this body is intact. Consequently we are driven to the conclusion that it is the vitreous body itself which presses upon the ciliary folds, and through them upon the iris-base. In the rare cases where the vitreous does not occupy its entire chamber, the pressure must come from the fluid accumulated behind it.

The inflammation of the trunk of the optic nerve has attracted less attention. It is developed just as strikingly in glaucoma distinctly due to blockage of the ligamentum pectinatum—for example, in cases of perforated corneal ulcer with prolapse of iris — as in primary glaucoma. The writer attributes it to infiltration of the ocular end of the optic nerve by fluid from the vitreous cavity. It is a question whether this infiltration, its existence being granted, is an entirely new development under the influence of the increased intra-ocular pressure, or whether it is simply an exaggeration of a normally existing flow. In favour of the latter view is the fact that the lymph-spaces of the optic nerve communicate with the canal of Cloquet, as well as with the sub-hyaloid space; and, more decidedly still, that swelling of the disc, narrowing of the peripheral part of the anterior aqueous chamber, and even, in rare cases, glaucoma itself, can be produced by compression of the optic nerve. Mooren states that the intra-ocular fluid of glaucoma is less albuminous, and consequently less coagulable, than normal. If so, the change in quality may have some deleterious influence on the tissues of the optic nerve. If we accept a normally existing outflow along the nerve, we must suppose this to be extremely slight compared with that by way of the ligamentum pectinatum; since experimental injections into the vitreous chamber have given no indication of their penetration in the nerve, and since all sorts of affections of the optic nerve may exist without a change in the tension of the eye. The widening of the nerve-entrance from stretching of the fibres of the lamina cribrosa would favour a flow of fluid into the nerve. We must, however, remember that to the ophthalmoscope the optic disc usually appears altered, prior to the establishment of any tension appreciable by the touch. But, on the other hand, we must bear in mind that even then pulsation of the retinal arteries is either present or very easily producible. Probably a long-continued slight hypersecretion may be got rid of through the normal outlets without producing any obvious rise of tension, and nevertheless may excite slow inflammatory changes within the ocular end of the optic nerve.

The advanced lens will naturally recede to its former position so soon as the pressure in front and behind it becomes equalised. This will be the case so soon as the ligamentum pectinatum becomes completely obstructed, and the secretion of the ciliary folds diminishes as the result of their shrinking. But the adherent iris must necessarily maintain its advanced position.

The various symptoms of glaucoma can also be explained by its pathology.

The dull and steamy appearance of the cornea, in inflammatory glaucoma, is due to distension of its lymph-spaces and an alteration in its anterior epithelial layer. The dull fundus reflex is due partly to this and partly to haze of vitreous, a result of its increased fluid and cell contents, which will also account for the halos and attacks of foggy vision. The failing accommodation is attributable to tension of the suspensory ligament of the lens and inelasticity of the sclerotic, both direct results of the distension of the eyeball and its approach to a spherical shape. The redness and subsequent atrophy of the disc are accounted for by the changes within the nerve. The limitation of the visual field, when temporary, is due to ischæmia of the retina. When permanent—i.e. when not remediable by the re-establishment of normal tension—it is due to the destruction of the nerve-fibres at the place where they are compressed along the sides and round the edge of the excavation. The inner part of the field is the first to go, since the arteries supplying the corresponding outer part of the retina have the longest course. The field for colour shrinks *pari passu* with that for form. But we must remember that the condition of the optic nerve itself must soon be sufficient to damage, and ultimately to destroy, both peripheral and central vision.

The pulsation of the vessels is a direct result of the diminished elasticity of the tunics of the globe from the pressure. The entry of the blood at each beat of the artery is no longer provided for by the slight dilatation of the globe which should normally occur. Consequently it is compensated by an immediate collapse of the vein to the same extent, and we have venous pulsation. Later, the increasing hardness of the globe allows an admittance of blood to the arteries at the moment of the systole only, and we have a visible arterial pulsation also. The pressure of the finger on the globe will diminish the elasticity of its coats, and thus give rise to pulsation of the arteries, the ease with which this is produced being a measure of the tendency to glaucoma. The paralysis of the iris and anæsthesia of the cornea are probably direct results of the pressure on the ciliary nerves, where they course between choroid and sclerotic. The dilatation of the pupil to a mere rim, as so commonly occurs in glaucoma absolutum, is due both to paralysis of the iris in association with the rolling forwards of its pupillary edge, and to the adhesion of its base to the peripheral part of the front wall of the anterior aqueous chamber. The cupping of the optic disc is in the main a direct result of the pressure. It is due to the atrophy of the nerve-fibres, both directly from the pressure and from the changes within the nerve. It takes time—probably at least a month in inflammatory glaucoma—for its complete development. It commences as a funnel-shaped central pit, which gradually extends till it reaches nearly or quite up to the margin of the disc, where a narrow, well-defined, white ring—the scleral ring—is often conspicuous. Gradually the nerve-fibres are pressed against its sides and atrophied here, as well as at its overhanging edge, so that the cup becomes flask-shaped in antero-posterior section—that is to say, its mouth is narrower than its cavity.

This overhanging, which need not involve its entire circuit, is due to the tapering of the normal optic nerve just before and at its entrance to the eye. This is a result of an anatomical change in the nerve-fibres, which normally lose their white matter of Schwann about the level of the lamina cribrosa, and are, consequently, for the rest of their forward course, represented by the axis-cylinders alone. The peculiar shape of the cup explains the apparent interruption of the vessels, as previously described. The most typical cupping is seen in glaucoma simplex. It is not well exhibited in the glaucoma of myopic eyes, probably from the distensibility of the thinned tunics of the globe. It used to be taught that a cup must occupy the whole of the disc, and, moreover, have an overhanging mouth in order to indicate a glaucoma. The idea is certainly incorrect as regards the first-mentioned condition, and apparently also as regards the last, since such a cup is not infrequently seen without any appreciable increase of tension. But it is certain that an extensive cup with undermined edges is typical of glaucoma, as compared with certain other conditions. For an atrophic cup, though extensive, is saucer-like, and a physiological cup, though its edge may be undermined, does not involve the whole of the disc.

Glaucoma probably depends upon some constitutional tendency or disturbance. It has been attributed to gout, but, though many patients with glaucoma undoubtedly have a gouty history, no such evidence has been hitherto collected as would warrant an absolute statement. The tendency to the disease is distinctly hereditary. Hypermetropia, excessive use of the eyes in near vision, uncorrected presbyopia, great anxiety, mental emotion or exhaustion, doubtless predispose to an attack.

Glaucoma is far more common as a disease secondary to other affections than in its primary form. Secondary glaucoma is encountered in the progress of most intraocular tumours, whether such be sarcomata of the uveal tract, retinal gliomata, or tuberculous. The effect of an intra-ocular growth upon the tension appears to be twofold. Its first and direct effect is to render the eye very slightly slack, possibly by the absorption of vitreous which it induces; an absorption which proceeds even more rapidly than the tumour grows. But the later outbreak of an inflammatory glaucoma is due to some cause not yet determined with precision. It probably varies in each case, being sometimes due to the blockage of the anterior outlets by the iris-periphery under the direct pressure of the now rapidly increasing tumour mass in the vitreous chamber. But more often the growth seems to prevent the flow from the vitreous chamber itself round the lens-margin. It is also a clinical fact that some tumours lead to shrinking of the eye without any manifestation of tension at any time, while others, large enough to reach nearly or quite up to the posterior lens-capsule, may exist for long with slightly diminished or normal tension.

Secondary glaucoma also occurs very commonly after perforated corneal ulcers. If the destruction affect a considerable area of cornea, the whole pupillary part of the iris prolapses into the gap thus made, and the pressure from behind applies the remaining part to the undestroyed cornea, thereby excluding most effectually all drainage by the canal of Schlemm. Similarly, after more extensive slough of the cornea, the exposed iris unites together, so that the pupil no longer exists. Thus a diaphragm is formed which becomes rapidly covered by a layer of lymph. Till this is slowly organised into dense fibrous tissue, it is incapable of resisting the intra-ocular pressure, and we have a prominent corneal staphyloma gradually formed. So soon, however, as a certain amount of firmness is gained, a secondary glaucoma is established. Prevention, by freeing the iris, is difficult, and relief of the glaucomatous condition, when once established, either by iridectomy or by any other procedure, still more difficult and uncertain. Indeed, little remains to us in the later stages but to mitigate the deformity, as far as possible, by tattooing the cornea, by abscission of the globe posterior to the ciliary body, or by enucleation.

Secondary glaucoma may also be produced in the course of iritis by adhesion of the iris to the anterior lens-capsule. In such cases the pupillary margin alone may be adherent (exclusion of the pupil), or the adhesion may involve a great part, or even the whole, of the posterior iris surface (universal posterior synechia). Thus, fluid is prevented from escaping by the anterior outlets of the eye, and we have a rise of tension with a diminution in the size of the anterior chamber.

It is remarkable that the pupil may be excluded and still the tension may remain perfectly normal, or even may be diminished, whether the iris be bulged or remain flat. Under the same circumstances increased tension may suddenly arise, or a hard eye become normal. The explanation resides in a varying amount of secretion of the ciliary body, according to its condition, whether normal, or inflamed, or inclined to atrophy after inflammation. The appearances in glaucoma from excluded pupil are characteristic, and the remedy simple. The central part of the anterior chamber is funnel-shaped, the apex of the funnel being formed by the pupillary area of the lens, and its base by the cornea. All the rest of the anterior chamber is extremely shallow, being encroached upon from behind by the bulged iris. An iridectomy will re-establish communication between the chambers, and effect very commonly the cure of the glaucoma. More extensive or universal posterior synechiæ are naturally less remediable by iridectomy. Indeed the indication for it is not so certain, since so extensive an iritis usually brings with it cyclitis and a subsequent softening of the eye.

Glaucoma also occurs commonly in the course of an iritis serosa. Since the secretion of the iris itself, especially its anterior surface, is here augmented, being, indeed, the cause of the increased tension, we have the anterior chamber markedly deep, and the iris-periphery pushed far back from the cornea. Numerous loosely arranged cells are found in the meshwork of the ligamentum pectinatum, and it has consequently been maintained that these produce the tension, by causing a direct obstruction at this, the point of outflow. This is probably not the case, since a similar accumulation of cells occurs commonly in suppurative iritis in association with normal tension. The most advantageous treatment of the tension of iritis serosa is not determined with certainty. If the disease has persisted for very long, the iris-periphery will usually be found applied, and the iris atrophied, as in an ordinary glaucoma absolutum.

Dislocation of the lens, whether into the vitreous or aqueous chamber, is very commonly followed by rise of tension. Indeed, slight lateral displacements appear just as liable to produce a glaucoma as the most extensive and violent changes of place. A displaced lens may block the meshwork of the ligamentum pectinatum by its presence in the anterior chamber, or by its direct pressure from behind upon a portion of the iris-periphery. Where such pressure cannot be proved to exist, it has been supposed that the displaced lens produces an irritative hypersecretion from the ciliary body by traction on the zonula. The question is not yet cleared up satisfactorily; but it is certain that the vitreous, after removal of the lens, or after its displacement with rupture of the hyaloid, is just as competent to thrust forward the ciliary folds and iris-periphery, as the lens would be with its normal attachments still unbroken. This result can scarcely be due to any other cause than swelling of the vitreous or an alteration in its shape. It is also to be noted that the tension due to lenticular dislocations may vary very much, a sudden outbreak of glaucoma being perhaps followed by a temporary period of diminished pressure. Secondary glaucoma, immediate or after the lapse of some months, was a common cause of entire loss of sight after the old cataract operation of couching or depression. Extraction of the displaced lens is the clearly indicated remedy, but it is not done without considerable difficulty, and there will almost certainly be loss of vitreous.

Wounds of the lens, accidental or operative, may be followed by glaucoma. In many such cases the lens is demonstrably swollen, and must encroach directly upon the cavity of the globe. To what extent it may have an indirect effect in closing the periphery of the anterior chamber or exciting an irritative hypersecretion from the ciliary folds, is less certain. The tension may be relieved by a speedy evacuation of the soft lens-matter by a curette through a small corneal incision, or by extraction of the lens *en masse* by the ordinary methods.

Glaucoma may supervene after a blow, without obvious structural change, or after a small perforating corneal wound with prolapse of iris.

Increased tension is also common in the course of suppurative panophthalmitis, and is doubtless directly due to swelling of the vitreous from abundant infiltration with cell-elements. It is not uncommon in uveitis of sympathetic origin. In both these cases the eye manifests a subsequent tendency to shrink; in the first, certainly, and in the last, probably. Scleral puncture or enucleation may be resorted to in suppurative panophthalmitis. In sympathetic disease we must be cautious about undertaking any operation, but, if the tension absolutely necessitates some interference, it will probably be found best to do sclerotomy.

High tension may also occur in the course of inherited syphilitic kerato-iritis, or indeed in the course of any serious affection of the uveal tract. In the former case it will often fall spontaneously to normal or even be followed by an abnormal softness of the globe. The need of an operation—best, probably, an iridectomy—will be determined by the probable effect of the tension on the nervous tissues of the eye.

Hæmorrhages between the choroid and retina are not infrequently the cause of a secondary glaucoma, especially in defective eyes. They are not uncommon in children, where they constitute one form of what has been described as pseudo-glioma.

It has already been stated that glaucoma may occur second in point of time to retinal hæmorrhage, in which case it is called hæmorrhagic glaucoma. This and the glaucoma which not infrequently follows plugging of the central vessels of the optic nerve may be, in reality, forms of secondary glaucoma; being perhaps related to an interference with the flow of lymph from the retina itself and vitreous cavity into the lymph-spaces of the nerve, either alone or, more probably, in association with some extensive vascular disease leading to an increased secretion from the ciliary body.

W. A. Brailey.

GLAUCOMA, Treatment of.—All authorities have agreed to make tension the diagnostic symptom of glaucoma, and with some practical reason, since it is the cause of a far more rapid deterioration of vision than would otherwise occur, and since it is the one condition we have some power of remedying. The effects of tension may be experienced by anyone making pressure with the finger on his own eye. The sight fails progressively from the circumference to the centre of the field of vision, and is re-established progressively on removing the pressure. The effects of removing morbid pressure are occasionally brilliantly demonstrable after operations for the acute inflammatory, and especially the fulminating variety of glaucoma. But, on the whole, the treatment of glaucoma can hardly be pronounced satisfactory. Except for combating any gouty, or possibly any general rheumatic, symptoms, and giving suitable glasses and instructions for the use of the eyes, we can do nothing in the premonitory stage. The question of proper spectacles, especially for near work, is, however, far more important than is often supposed. It is very probable that an iridectomy or, better, a sclerotomy, might check the further development of the pressure, but few surgeons would propose, or few patients would risk, an operation while still vision was good and an increase of tension but doubtful.

With regard to drugs, the subcutaneous injection of morphia (gr. $\frac{1}{6}$ of the hydrochlorate) under the skin of the temple will relieve the pain and, very occasionally, even reduce the tension to normal. A violent purgative has also a distinct reducing effect on the tension, but we may lay down generally that the known action of all drugs is at present simply temporary. Undoubtedly the most valuable is the Calabar bean, which in the form of a solution of the sulphate of its alkaloid, eserine (gr. ij. ad f℥j.), will sometimes restore normal tension. It is well established by observation that the tension is only reduced when the drug is able to exert to the full its myotic action. Doubtless eserine diminishes tension by gathering the iris more towards the centre of the pupil, so that its peripheral part is thinner and the fibres of the ligamentum pectinatum well stretched apart. Consequently, fluid can transude freely through the periphery of the anterior chamber. On the same principle, atropine, by dilating the pupil, has a tendency to precipitate a threatened glaucoma, the widely dilated iris being much thickened, and the periphery of the anterior chamber, towards which it is gathered, correspondingly narrowed. There has been much misapprehension as to the relative actions of atropine and eserine. For, while the one raises and the other lowers tension by the above-described mechanical action, each drug has an influence of its own on the secretion of the intra-ocular fluids, in an entirely opposite direction. Thus, atropine, by diminishing the secretion according to its well-known action in other regions of the body, tends to lower the tension, and would do so were not this influence more than counterbalanced by the results of its mechanical action on the iris. In the same way, eserine would make the eye harder, were it not that its mechanical action more than counterbalances its influence on the secretion of fluids. It therefore follows that eserine is useful when it contracts the pupil, but that it is actually deleterious in all other cases; also, that atropine may be usefully employed where a rise of tension is associated with a pupil immovable from iritic adhesions, but that it should be sedulously avoided in all cases of threatening glaucoma with unadherent pupil. The weakest solution of eserine that will produce extreme myosis is consequently the best adapted for glaucoma.

Operative treatment is of more avail in glaucoma. Statistics show improvement of sight after operation in about 25 per cent. of the cases of glaucoma simplex, and an actual deterioration of vision in another 20 per cent. The remainder stand in much the same position as regards vision as previous to the operation, though the future course of the disease must be modified beneficially from the reduction of tension which usually occurs. In inflammatory glaucoma, about half the cases are improved in vision, the bulk of the others remaining stationary in this respect. We know, however, that they would all steadily get worse if they remained unoperated upon. The most useful operations are iridectomy and sclerotomy. Others are scleral incision, trephining the sclerotic, hyposcleral cyclotomy, and paracentesis corneæ.

The last has its principal use in reducing tension pending the adoption of some more radical measure. Cases are on record in which such a simple puncture has cured a glaucoma, but anyone expecting to meet with even one such result in his lifetime will probably be doomed to disappointment. It can be performed from below—the best position—with a special broad-pointed stop needle (paracentesis-needle), with the point of a keratome, or with an ordinary broad needle. No anæsthetic is required, provided the operator is moderately skilful. It is surprising how quickly the increased tension and the anterior chamber may become re-established after paracentesis.

Iridectomy was introduced by the genius of Von Graefe in 1856, after a long series of operations, experimentally performed upon animals, had demonstrated to him its utility in reducing the tension of the normal eye.

It still remains the most reliable remedy we possess against inflammatory glaucoma, in both its acute and chronic forms. An anæsthetic should be administered for either iridectomy or sclerotomy. Cocain will, as a rule, not suffice for the perfect quiet which is essential. Chloroform, if not contraindicated by the general condition, is preferable to ether, from the vascular congestion attendant on the latter. The operation is performed with a triangular knife or keratome, whose handle in the immediate neighbourhood of the blade is bent upon the flat, for convenience of operating from above, the usual position. The blade should be of fair size, about 9 mm. in diameter at its widest, and of a length rather greater than this. Some use a smaller size, thereby necessitating a sideways movement in the act of withdrawal, a proceeding not unattended with risk of traumatic cataract. The point of the keratome enters the sclerotic at least 1 mm. behind the apparent corneal margin, care being taken to keep the incision parallel with this. The steady onward movement is facilitated by the use of the fixation-forceps, which take a firm hold of the conjunctiva near the lower corneal margin. So soon as the point of the keratome, which was at first directed towards the centre of the lens, is visible in the anterior chamber, it is turned more forwards, so that the instrument lies, in the rest of its course, perfectly parallel with the plane of the iris. It is quickly and steadily withdrawn so soon as it has traversed about three-fourths of the anterior chamber. During its introduction it should fit the wound so accurately that none of the aqueous fluid escapes by its side; otherwise the lens may be thrust forward on its point.

The keratome is now laid aside and the scissors taken in the right hand, and the iris-forceps in the left. Fixation of the globe by an assistant will probably be necessary. Should the iris not facilitate matters by prolapsing, the closed forceps are cautiously introduced into the anterior chamber, not quite so far as the pupillary margin of the iris, and then opened. The piece of iris grasped by them should be as large as can be safely managed. After being carefully withdrawn it is first cut with the scissors at the extreme right-hand angle of the wound by an incision extending radially to the pupil, and then torn cautiously from its peripheral attachments up to the left-hand angle, where a second radial cut frees it altogether. A certain amount of gentle traction during each cut will ensure that the remaining iris retracts sufficiently to prevent the risk of an anterior synechia. Otherwise, it should be pushed from the wound by some flat, blunt, spud-like instrument made of vulcanite or tortoiseshell. The removed iris should amount to at least one-fifth of the whole.

It is most important that the forceps during fixation should exert no downward pressure on the globe. Nor should it tend to lift it up, but rather rotate it very gently, slightly, and steadily towards the keratome. Some incline the point of the keratome sideways just before commencing to withdraw it, so as to make the length of the internal equal to that of the external wound. Both eyes are kept loosely tied up for two days, and the lint is kept wet and is occasionally changed. During this time rest in bed will be advisable. Then the unoperated eye may be opened under a shade, dry lint being henceforward used to the operated eye. At the end of ten days this may be cautiously exposed to the light, provided that the wound is healed and the anterior chamber fully re-established. But the rapidity of re-formation of the anterior chamber varies much, and may be taken as indicative of the future course of the case. In any case it is much slower, on the average, than after iridectomy on non-glaucomatous eyes. In rare cases the lens and iris remain permanently applied to the cornea without any reduction of tension at any time. To such cases the name of malignant glaucoma has been applied.

When the tension, though still exceeding the normal, has fallen somewhat after an iridectomy, it becomes a question whether a further removal of iris in an opposite direction (diametric iridectomy), or even a sclerotomy, may not be practised advantageously. Tension may, however, remain somewhat in excess, and the eye still be materially benefited by the operation. In such a case it would be prudent to go no further. A Graefe knife may be employed in making the first incision, when, from the great shallowness of the anterior chamber, the use of a keratome would appear to endanger the lens. If the condition of the second eye give rise to anxiety, it is advisable to instil eserine into it, both before and for a day or two after the operation, for the sake of guarding against the outbreak of tension to which the operation on the first eye appears to predispose it.

The accidents attending iridectomy are: wounds of the lens, escape of the lens or of the vitreous and even of the retina, entanglements of the iris in the wound, and intra-ocular hæmorrhages. An ill-made keratome, by allowing premature escape of the aqueous, is likely to be the cause of a traumatic cataract. A Graefe knife, though less likely to injure the lens, has the great disadvantage that, making a larger wound, it allows of a very sudden reduction of the intra-ocular pressure. Thus the danger of rupture of the lens-capsule and of escape of lens, and even vitreous, is greatly increased. The same with regard to intra-ocular hæmorrhages, which, if in the anterior chamber only, may be safely disregarded, but, if in the vitreous, are apt to lead to serious loss of sight. If they are posterior to the retina they may cause an immediate exacerbation of tension, with such prolapse of vitreous, and even of the retina, as may render an immediate enucleation necessary.

Sclerotomy is performed by entering the point of a narrow-bladed Graefe knife 2 mm. behind the apparent corneal margin, and then traversing the anterior chamber parallel to and just in front of the anterior surface of the iris, till a corresponding counterpuncture is made. The incision should comprise a third part, usually the upper, of the entire circle in which it lies. The sclerotic is then divided by gentle sawing movements till only a narrow bridge, 2 mm. wide, remains unsevered. The conjunctiva, yielding to the knife, will only be cut at the points of puncture and counter-puncture. The knife is withdrawn with extreme care, so as to prevent prolapse of the iris. Eserine sulphate (gr. j. or ij. ad f ℥j.), is instilled as a further precaution, and repeated thrice daily for some days, provided always that it contracts the pupil. Otherwise the after-treatment is as in iridectomy. It is here also a special point that the bandage should not be firmly applied. The special risk attending sclerotomy, in addition to that of wounding the lens, is entanglement of the iris in the wound. Should this happen during the operation, it will be well to complete the incision, with the knife if it be still in the anterior chamber, or with scissors, and make the sclerotomy into an iridectomy. If the incision be too far back, we have all the risks attendant on wounds of the ciliary region, including those of sympathetic ophthalmitis and deep-seated intra-ocular hæmorrhage. The possibility of a glaucomatous outbreak in the second eye should be guarded against with eserine, as prescribed in iridectomy.

Either sclerotomy or iridectomy may be followed by the condition known as cystoid cicatrix, in which the operation scar at one point, usually near or at an extremity, remains thin, bluish, and prominent. The condition is most plausibly explained by entanglement of a point of iris in the scar. It is usually supposed that a cystoid cicatrix, by allowing occasional leakage, relieves exacerbations of tension. If so, this advantage is too often counterbalanced by the irritation to which this condition gives rise. Its treatment should not be lightly undertaken. It may be cut through with a Graefe knife, and afterwards treated with a compressive bandage and perhaps the occasional use of mitigated nitrate of silver stick. Such treatment, will, however, certainly not be ventured upon if the eye continues hard.

A sclerotomy may be repeated one or more times, or may be followed by an iridectomy. Sclerotomy is certainly preferable to the latter operation in glaucoma simplex, especially if attended with great limitation of the field of vision, also in the hæmorrhagic forms of glaucoma, and for increased tension in young subjects. It has the advantage over iridectomy that it does not deteriorate vision by altering the shape and size of the pupil.

Another operation sometimes employed in glaucoma has been called 'scleral puncture.' An incision, some quarter of an inch long (6 mm.), is made through the sclerotic into the vitreous chamber in an antero-posterior direction. It should lie entirely posterior to the ora serrata, that is to say, it should be at least 6·5 mm. from the apparent corneal margin. The knife, which may be an ordinary keratome, should pass some distance into the vitreous chamber, perhaps as far as the canal of Cloquet. The incision should be between two of the recti tendons, perhaps preferably between the superior and external. After the escape of some of the contents of the globe, such being lymph or thin vitreous, the eye is bandaged carefully, as after iridectomy. For the most part the more thoroughly tried procedures of iridectomy and sclerotomy will be preferred to scleral puncture. But the latter has this advantage, that little reaction follows it, and, being done without an anæsthetic, it can be readily repeated. Its results, provided that repetition be not feared, are spoken of not unfavourably. It is certainly the best operation in cases where the anterior chamber is entirely wanting. In these an attempt may at the same time be made to push back the lens by manipulation of the cornea. The lens may be wounded in an incautiously performed scleral puncture, or the operation may cause extensive intra-ocular hæmorrhage.

An incision through the ciliary body antero-posteriorly has also been recommended. A narrow-bladed Graefe knife is introduced near the corneal margin, usually the upper, and pointed directly backwards, so that its blunt back is toward the edge of the lens. The ciliary body is cut through right up to and against the sclerotic. Though this operation, which has been named *hyposcleral cyclotomy*, sometimes reduces the tension, as indeed any incision near the sclero-corneal junction may, it can do much harm by causing intra-ocular hæmorrhage or inflammation, or by wounding the lens.

Trephining through the sclerotic has been recommended and practised by Argyll-Robertson in cases which seem not likely to benefit by the ordinary operations. The incision is made about the level of the ora serrata by the cutting extremity of a steel cylinder, which is rotated between the fingers. It is extended into the vitreous chamber, so that some of the contents of the latter escape. Subsequent treatment is by wet lint and quiet. The operation is attended with more reaction than iridectomy or sclerotomy, and should therefore, if only on this ground, be deferred in favour of a repetition of these more fully tried methods.

Any of the above described operations may be of benefit by the free drainage that must occur before the reunion of the wound; and, presumably also, by the relief to arteries and capillaries from removal of pressure from the walls of the different venous trunks.

The special beneficial action of iridectomy is due to the removal of a portion of the iris from its contiguity with, or close apposition to, the meshwork of the ligamentum pectinatum. This operation is consequently expressly indicated in cases of inflammatory glaucoma, especially where the anterior chamber is very shallow. It is less suitable to glaucoma simplex generally, and least of all to those long-standing cases where the field of vision is encroached upon nearly up to, or beyond, the fixation-point.

An ample and well-performed iridectomy may be followed by no reduction of tension, or even by an exacerbation. Such cases should be scrutinised carefully, since it is not impossible that the tension may be due to the presence of an intra-ocular growth. It must, however, be remarked that an eye may retain some hardness immediately after the performance of the operation, and yet regain normal tension in the course of a few days. These remarks apply also to sclerotomy.

The way in which this last-named operation reduces the tension is not quite so obvious. It certainly does not act by producing a permeable scar, across which fluid can pass from the anterior chamber to the exterior. More probably a new path is established by which fluid can reach the corneal and scleral lymph-spaces from the retraction of the cut membrane of Descemet (the posterior elastic lamina). However peripheral the operation wound may appear, it is almost invariably found, on post-mortem examination, to be substantially in advance of the ligamentum pectinatum and canal of Schlemm. Sclerotomy is especially indicated in glaucoma simplex, and in those cases where intra-ocular hæmorrhages are likely, such being the hæmorrhagic and very advanced forms of glaucoma, and also the glaucoma of young subjects.

An operation is indicated in all cases of inflammatory glaucoma, except where the perception of light is permanently gone. Its benefit is most doubtful in cases of glaucoma simplex, especially where there is much contraction of field. But it is to be said, even in such cases, that, after a trial of the drugs we have previously discussed, it is the only remedy remaining to us. It is proper to remember that the ultimate effect of an operation is often much better than would appear probable within a few weeks of its performance.

Some cases of glaucoma absolutum cause little or no inconvenience, but others are attended by severe peri-orbital or ocular neuralgia. For this, enucleation is our most sure resource; but, if it be a great object to retain the eye, stretching of the supra-trochlear branch of the fifth nerve may be tried. The operation is performed by making a skin-incision, some 10 mm. long, across the track of the nerve as it emerges from the upper and inner border of the orbit. A line drawn from the angle of the mouth through the inner canthus may be taken as a guide to the course of the nerve. It is best to extend the incision at once right down to the periosteum, at the extreme outer and inner ends of the wound, and then to divide or tear through the remaining bridge, bit by bit, upon a strabismus hook. The nerve, which lies very deeply, may be stretched on the hook till it ruptures. This operation has been vaunted by its introducer, Badal, and by others, as a remedy, not only against neuralgia, but also against increased tension. The writer, though admitting that it has undoubtedly some general effect upon the tension, has not found it of real service in ordinary cases of primary glaucoma. It may, however, be employed as a subsequent adjuvant to other operative procedures, and it is undoubtedly useful against the neuralgia of glaucoma absolutum.

W. A. Brailey.

GLEET.—This term is usually applied to the slight and chronic discharge from the urethra, which so frequently follows an attack of acute gonorrhœa. The discharge is, as a general rule, very scanty, just rendering the surface of the urethral mucous membrane moist and sticky, passing away in the early morning in one or more drops of clear or slightly turbid fluid, and in the course of the day barely staining the patient's linen. This condition is sometimes associated with pain at the end of the penis, with slight itching along the urethra, and with a sensation of fulness in the perineum. It is, as a rule, a strictly chronic affection, and in most instances it is a direct continuation of the third stage of gonorrhœa, though occasionally it begins after an interval of two or three weeks from the date of complete disappearance of discharge from the urethra. The general condition in gleet is often faulty, the patient being feeble and pallid, and manifesting a tendency to chronic catarrh. The affection, though characterised by such mild local symptoms, is one of some gravity on account of its persistency, of the mental depression which it often induces, and of the decided and constant tendency in its subject to recurrence of acute inflammation of the urethra. Moreover, it is often indicative of prostatic and vesical mischief, and may be associated with stricture of the urethra.

The diagnosis of true gleet from the gleety discharges associated with hypertrophy of the prostate, old stricture, and warty or polypoid growths in the urethra, may, in most instances, be readily determined by inquiry into the history and clinical features of the case, or by instrumental exploration of the canal. In chronic gonorrhœa the discharge, as was pointed out by Fournier, is always profuse, and decidedly purulent.

The pathological condition, which gives rise to the symptoms of gleet, is very probably a chronic inflammation of the mucous membrane of the bulbo-membranous portion of the urethra. There cannot be any doubt that gonorrhœal inflammation, as it subsides, becomes restricted to the deep portion of the urethra, and has a tendency to persist there in a chronic form. Desormeaux, in his endoscopic researches on gleet, made out a granular condition of the urethral mucous membrane, which he regarded as the special lesion of the affection. According to this surgeon, 'When gonorrhœa passes into a chronic form, the mucous membrane of the urethra at the affected region becomes uneven, and, after a time, presents small hemispherical granulations which are irregularly and sometimes thickly dispersed on a deep red surface. These granulations, which vary much in size, frequently occupy from two to four centimetres of the extent of the urethral canal, and sometimes the whole of its posterior part, from the proximal end of the spongy region to the orifice of the bladder. One almost constant character of this lesion is its continuity. Whether it involve much or little of the urethral wall, there is no interruption between its two extremities, and there are no scattered patches separated by healthy mucous membrane. Sometimes the granulations swell, lose their hemispherical form, become softer, and acquire the aspect of the granulations of a healing ulcer. The affected surface then resembles, in the field of the endoscope, that of a suppurating wound. This ulcerative process may extend still further, and become fungous.' These lesions follow an essentially chronic course, and, Desormeaux asserts, inevitably lead to stricture. *See* ENDOSCOPE.

In the treatment of gleet it is very necessary to attend to the general health. The patient should be put on a plain but abundant and nourishing diet, and be advised to make frequent changes of air and scene, if possible, without going through too active exercise. He should abstain from wine, beer, and tea, and take as drink as much milk as he can digest, with small quantities of whisky or gin in some aërated water. Cold or tepid baths will be found beneficial. The medicinal treatment, unless the urethral discharge be kept up by some diathetic condition, should consist exclusively of one-drachm doses of the compound syrup of phosphate of iron every morning, and from three to five minims of tincture of cantharides, in one ounce of water, three times a day. The local treatment should consist in the introduction, every fourth or sixth day, of a metal catheter of such size as to permit its easy passage along the whole extent of the urethra, and in the daily application of an astringent solution to the posterior part of the canal by means of Tiemann's syringe, or of Harrison's irrigator. The following are some of the most useful injections that have been tried in the treatment of gleet:—Sulphate of zinc (gr. iij. to f℥j.), sulpho-carbolate of zinc (gr. jss. to f℥j.), nitrate of silver (gr. j. to f℥j.), bismuth (ʒss. to f℥j.), tannin (gr. v. to f℥j.), tincture of iodine (♏v. to f℥j.).

In any very obstinate case of gleet, it might be found advisable to apply, as a last resource, blisters to the perineum and the root of the penis. W. JOHNSON SMITH.

GLIOMA. *See* Orbit, Tumours of the; Sarcoma.

GLOSSITIS. *See* Tongue, Diseases of the.

GLUE-BANDAGES. *See* Immovable Bandages.

GLUTEAL ANEURISM.—In cases of aneurism of the buttock, the gluteal is the artery most frequently affected, but the sciatic is not uncommonly involved, and cases are on record where the internal pudic crossing the spine of the ischium, or an abnormal 'sciatico-popliteal' artery has been diseased. To diagnose whether a 'diffused' aneurism implicates the gluteal or the sciatic artery, must always be difficult, and may be impossible; when sacculated, a sciatic aneurism will probably be lower and more deeply situated.

Gluteal aneurisms are spontaneous or traumatic, circumscribed or diffused. In the *spontaneous* variety the aneurism is more likely to be sacculated, and both the vessel itself and the iliacs diseased, than when it is traumatic in its origin; it is often not entirely extra-pelvic, small, deeply-situated, and consequently hard to diagnose. Pulsation and bruit may be detected in the sacculated form, but both may be absent if the sac has given way, and the aneurism has become 'diffused.' Other symptoms met with are pain, not only in the buttock but also along the back of the thigh from pressure on the sciatic nerve, flexion, and some loss of mobility of the limb. The integument may become inflamed from pressure in sitting or some local irritation.

Traumatic aneurisms, which are far the most common, are due to a wound or subcutaneous rupture of the artery. The vessel itself is more likely to be diseased in this latter case; in both the aneurism is probably entirely extra-pelvic; yet this is not necessarily so, for the artery may be wounded before it has passed through the sacro-sciatic foramen, or, when cut across or ruptured, retract within the pelvis.

A traumatic sacculated aneurism will give rise to much the same symptoms as a spontaneous sacculated one; but with the accompanying history of a wound or injury should be easier of diagnosis. The majority of these traumatic aneurisms have, however, no sac except such as is formed by the soft parts; and consequently present themselves as tense fluctuating tumours, devoid of pulsation, in which it may be very difficult or impossible to detect a bruit. Such a one may thus readily be mistaken for a simple blood-tumour, or even, if the integuments are inflamed, for an abscess. Careful search must be made for a bruit, supplemented if necessary by an exploratory puncture before a diagnosis can be arrived at or any treatment adopted. The same precautions must be taken in cases of spontaneous aneurism where the sac has given way and pulsation is absent. In all cases the surgeon should, by rectal examination (and in the female per vaginam also), see if the aneurism is at all intra-pelvic. The condition of the pelvic bones, of the large vessels, and the effect of compression of the latter, may also in this way be ascertained. More details as to the *diagnosis* are given in the article Gluteal Region. It is enough here to say that pulsating gluteal aneurism, especially when spontaneous, has to be diagnosed from pulsating sarcoma of the bone; a non-pulsating aneurism from simple hæmatoma, abscess, non-pulsating sarcoma, enlarged subgluteal bursa, or possibly sciatic hernia.

The *treatment* must depend on whether the aneurism has, or has not, a proper sac, whether it is entirely extra-pelvic, and whether the vessels are likely to be found healthy. In cases of 'diffused' extra-pelvic aneurism, especially when traumatic, the old operation of Antyllus should be performed. It will be found that the sac, such as it is, is much nearer the surface than would have been supposed. In such a case, under the care of the writer, all hæmorrhage, during the operation, was readily restrained by Davy's rectal lever. If this is not used, pressure must be made on the common iliac artery or aorta by some abdominal tourniquet.

In the other forms an endeavour to effect a cure by pressure, under ether, on the large abdominal vessels, either from the rectum or by means of a tourniquet, should be made. Such pressure may be supplemented, when the sac is entire and the circulation commanded, by the use of coagulating injections or galvano-puncture. Pressure from the rectum for any length of time must be made by the hand; Davy's lever could hardly be safely employed for such a purpose. If these means fail to effect a cure, and the aneurism is increasing in size, other measures must be taken. When the swelling is partly intra-pelvic, ligature of the internal iliac may be the only resource left, although this proceeding is both difficult, and dangerous from the likelihood that the vessel itself will be found diseased; when extra-pelvic the old operation is the safer proceeding, or Anel's operation in rare cases may be practicable.

Wound of the gluteal artery is the result of stabs or punctured wounds of the buttock, and it may be uncertain whether it is the trunk, or one of the branches, from which the hæmorrhage proceeds. If this be free and evidently arterial, the surgeon must at once, by enlarging the wound, expose the artery, and tie or twist it on each side of the opening into it. During the operation the rectal lever may be employed; and if the exact source of the hæmorrhage is not to be seen, the pressure should be momentarily relaxed, so that the bleeding may disclose the situation of the wounded artery. If this is intra-pelvic, out of the surgeon's reach, and the hæmorrhage continues, the internal iliac artery must be tied. George Robertson Turner.

GLUTEAL REGION.—The skin of the nates, when it is affected with *molluscum fibrosum*, may be much enlarged, loose, and pendulous, from an overgrowth of the subcutaneous tissue: more circumscribed *fibrous* or *fibro-cellular tumours* are also met with. These have a slow painless growth, do not implicate the skin, and, when occurring in the subcutaneous tissue, are freely movable. They are uniform in consistence unless, as sometimes happens, they have undergone cystic degeneration. *Sebaceous tumours*, when small, round, tense, and partially adherent to the skin, are easy of diagnosis; but when larger, may be confounded with *fatty tumours*. Both increase in size slowly, and without pain; but lipomata are lobulated, and often give rise, when compressed, to a characteristic dimpling of the skin over them. They are sometimes congenital. Much more frequently congenital, however, are *nævi*, which, when subcutaneous, form bluish masses, becoming tense when the child cries. They may undergo cystic degeneration, and possibly, if there is no accurate history, be confounded with fatty or fibro-cellular growths.

Gummata may occur in syphilitic subjects, either in the subcutaneous tissue, or more deeply in the substance of the muscles. They form rounded masses, which either yield to treatment, or soften and break down, eventually discharging their contents and leaving an excavated honeycombed ulcer. *Simple* or *hydatid cysts* may also be met with in the muscular substance, giving rise, if the swelling is at all large, to fluctuation. Exploratory puncture will lead to a diagnosis, but this may not be necessary if the thrill peculiar to hydatids is present.

Wasting of the glutei, leading to *flattening of the buttock* and loss of its fold, may result from simple disuse, infantile paralysis, morbus coxæ, congenital dislocation of the hip, sacro-iliac disease, and suppuration of the subgluteal bursa. Wasting from simple disuse is frequently seen where the long splint has been used, or where the limb in some other way has been kept motionless for any length of time. Other muscles than the glutei participate in the wasting, and, if the condition of parts is such as to admit of it, exercise and massage will soon be followed by a return of the muscles to their normal size. In infantile paralysis the onset of the disease is sudden, other muscles are usually implicated, and passive motion of the hip-joint is free; whereas, if disease of this articulation is present, movement, especially abduction and rotation outwards, is painful. The pain is often referred to the knee as well as to the hip, the thigh is flexed, and the joint fixed by muscular action so that the pelvis, which is usually tilted, moves with the femur. In *congenital dislocation of the hip*, which may affect one or both sides, the patient limps and waddles, if old enough to walk. There may be wasting of the muscles, but passive motion of the hip is painless; the trochanter major projects above Nélaton's line; there is shortening of the limb, great prominence of the buttock, lordosis of the lumbar vertebræ, and, if unaltered in shape, the head of the bone may be felt on the dorsum ilii.

Abscess of the buttock may be simple, or due to hip, sacro-iliac, pelvic, or vertebral disease. It may depend on suppuration of the subgluteal bursa, and in rare instances a parametritic abscess may show itself in the neighbourhood of the sacro-iliac joint. An abscess coming from a distance may pass through the sacro-sciatic foramen and present in the buttock. Such a one will be partly reducible, and perhaps have impulse on coughing. When due to *sacro-iliac disease* the formation of abscess has been preceded by muscular wasting, puffiness over the dorsal aspect of the joint, pain whenever the weight of the body is brought to bear on the pelvis or on pressing its walls together transversely; and although there may be lengthening of the lower limb on the affected side from tilting of the pelvis, measurement between the anterior superior spine of the ilium and the malleolus is normal. When due to *hip-disease* its formation has been preceded by the early symptoms of that disease, and examination under ether will very likely disclose erosion of the cartilages and disorganisation of the joint; when due to *vertebral disease* there will be, even if there is no angular curvature, rigidity and pain on percussing the spines of the affected region. The abscess may have passed out of the sacro-sciatic foramen, or be due to caries of the last lumbar or sacral vertebræ. Abscesses *dependent on diseased bone* as a rule do not attain so large a size as when a joint is affected, and, until they burst or are opened, their origin cannot with certainty be determined.

Suppuration of the subgluteal bursa seems to follow blows on the great trochanter, and may in some cases closely simulate morbus coxæ. There may be the same flexion of the thigh, fixation of the pelvis, wasting of the buttock, and immobility of the joint; but under ether the muscular rigidity will subside, and the hip can be moved freely; there is no shortening, no pain in the knee, and the patient can bear pressure, either direct or indirect, on the joint. If the abscess is opened and the finger introduced, the disease will be found to pass beneath the gluteal aponeurosis over the great trochanter. In such abscesses the swelling extends over the upper third and outer part of the thigh, and consequently is on a lower level than that of a gluteal aneurism.

Simple *enlargement of the subgluteal bursa* may appear rapidly without constitutional disturbance, and subside with rest and blistering. If there is any doubt of the diagnosis exploratory puncture may be necessary. A blood-cyst or *hæmatoma* presents as a fluctuating swelling, rapidly following an injury, and may attain a large size in this region. The skin over it is often bruised and discoloured; it may be distinguished from abscess by its more rapid onset and—at least at first—by the absence of inflammation. In doubtful cases exploratory puncture may be necessary. A simple hæmatoma may be confounded with a non-pulsating aneurism, but it has no bruit, is less tense, and has less tendency to increase in size, usually becoming smaller from absorption of the effused blood. Blood-cysts have been known to pass through the sacro-sciatic foramen and present in the buttock.

Gluteal aneurism, when sacculated, presents as a swelling, usually about the size of a hen's egg, at the upper part of the sacro-sciatic foramen, and is accompanied by pulsation, bruit, and, it may be, thrill, together with pain in the buttock and along the course of the sciatic nerve, and often flexion of the limb. Such a swelling can only be confounded with a pulsating tumour of bone; but if the sac has in part given way, or the aneurism has from the first been without a proper sac, without pulsation, but fluctuating and with inflamed integuments, it may readily be mistaken for abscess, but may be distinguished from it by the existence of a bruit. This should be carefully sought for, on more than one occasion, with the patient in different positions. If it be not detected an exploratory puncture should be made before the supposed abscess is incised. *Malignant tumours of bone* have a rapid growth, and are soon accompanied by loss of flesh. They often pulsate, and, even when non-pulsating, they may be mistaken for gluteal aneurism. They are sarcomatous, and may be traversed by bony spicula, or may have an imperfect osseous envelope, and soon, even if they have commenced on the outer, involve the inner or pelvic aspect of the bone. This fact may be elicited under ether by careful examination of the iliac region, and rectal examination of the interior of the pelvis. A gluteal aneurism could hardly erode the bone to such an extent as to present in the iliac fossa. The pulsation of tumour of bone is unaccompanied by the lateral expansion of an aneurism, and the bruit, if present at all, is not so constant, distinct, or harsh, but rather of a soft cooing character. Pressure on the common iliac artery by Davy's lever, so as to command the circulation during the examination of the tumour, might possibly assist in its diagnosis; but the depth and smallness of the gluteal vessel is such as often to make it difficult for the surgeon to decide whether he is dealing with an aneurism or tumour of bone.

Sciatic hernia is most rare, and might possibly be mistaken for aneurism or abscess passing through the sacro-sciatic foramen. It would have impulse on coughing, and, if reducible, re-enters the pelvis with a characteristic gurgle. Even if irreducible, it is still devoid of bruit or pulsation, and probably is in part resonant on percussion. Cases are on record where the swelling disappeared on the patient lying down, to reappear when the erect position was assumed. In one case, where the tumour was large, it had passed down and bulged as a prominent swelling, as big as a fœtal head at full period, at the lower border of the gluteal fold over the upper and inner part of the opposite thigh. On reducing a portion of the contents of the sac the edge of an indurated opening overlying the sacro-sciatic foramen could be felt.

Innocent tumours of the ilium are usually *enchondromatous.* They can be recognised by their slow growth, hardness, elasticity, broad base, fixed position, and evident connection with the bone. They are often nodulated, and perhaps can be felt in the iliac fossa as well as on the dorsum ilii. The diagnosis between them and *fibrous* tumours springing from the bone must be very difficult, if not impossible. An *exostosis* is hard, incompressible, usually sessile, grows slowly and regularly, attaining only moderate dimensions.

A specimen of *hydatid cysts* expanding the walls of the ilium is to be seen in the museum of St. Bartholomew's Hospital.

George Robertson Turner.

GLYCOSURIA. *See* Back and Spine, Injuries of the.

GOÎTRE. *See* Thyroid Gland.

GONORRHŒA.—Gonorrhœa in the *male* is a specific and contagious form of urethritis, producing in its most advanced stage an abundant purulent or muco-purulent discharge. Whether gonorrhœal inflammation ever attacks the mucous membrane of the nose, mouth, external ear, or anus, still remains very doubtful.

In a very large majority of cases gonorrhœa is caused by contagion, and the direct application of gonorrhœal discharge to the male urethra during intercourse with a woman similarly affected. There can be no doubt, however, that urethritis closely resembling gonorrhœa, though perhaps not so acute nor so prolonged, may result from the contact of other morbid discharges from the vulva, and also from excessive irritation of the urethra, through much sexual intercourse, free drinking, violent and continuous catheterism, &c.

Symptoms.—The earliest symptoms of gonorrhœa are usually noticed in the course of the fourth day after exposure: sometimes, though very rarely, they occur as early as the second or as late as the seventh day. The patient complains at first of uneasiness about the meatus, and of slight smarting along the urethra during micturition. At this stage there is often a scanty discharge of clear mucous fluid from the end of the urethra. These symptoms become more marked in the course of the next two days, and are gradually developed into the distinctive signs of intense urethritis. The lips of the meatus are now very red and swollen, the prepuce has become slightly œdematous, and the glans penis is turgid and its surface congested and glossy. The discharge from the urethra is profuse and almost continuous, changing in colour as the inflammation increases, from white to yellow, and in very severe cases to pale green. The whole penis is hot and swollen, and its surface is slightly congested, and in some instances marked along the dorsum of the organ by red and inflamed lymph-vessels. Along the course of the hardened and very tender urethra one or more small swellings, caused by follicular inflammation or suppuration, may occasionally be felt.

The passage of urine over the inflamed mucous membrane of the urethra is attended with intense pain, and at the same time there is constant irritation at the neck of the bladder, and a frequent desire to micturate. At first the urethral tenderness is restricted to the region of the navicular fossa, and subsequently it passes gradually backwards towards the bladder until the whole length of the canal becomes very sensitive. The patient often complains of pain across the lumbar region, and a sensation of heaviness in the pelvis; the perineum becomes very sensitive, and the scrotum and testes may also share in this diffused irritable condition. The inguinal glands are usually swollen and painful, but very rarely suppurate. In this acute stage much suffering is caused by frequent erections, especially when the patient is warm in bed. In consequence of the distension being partial, the penis is bent so as to form an arch with its concavity downwards, and thus presents the very painful condition known as chordee. The acute stage usually lasts until the end of the second week. It is, as a rule, more severe in the first than in any repeated attacks of gonorrhœa. The more intense the inflammation in any attack, the less prolonged is the duration of the acute and painful symptoms of the affection.

In the next stage—that of decline—the urethral tenderness and the pain during micturition gradually diminish, together with all the objective signs of acute inflammation. At the same time the discharge becomes much less profuse and loses its purulent character. The duration of this stage varies much in different cases. In the most favourable attacks the improvement is steadily progressive, and the patient is quite well at about the end of the sixth week. More frequently, however, a clear mucous discharge, together with slight tenderness along the urethra, and frequency of micturition, persists for several weeks or even months. During this period of persistent irritation the patient is very liable to relapse, particularly after imprudence in diet or conduct, or carelessness in keeping up the treatment.

An attack of gonorrhœa is often followed by a condition, more or less prolonged, of imperfect recovery, in which there is a scanty and occasional discharge of pale glairy fluid. This condition, which is seldom marked by any other local symptoms, is known as that of gleet. In some few instances a thick, yellow, and purulent discharge persists for a long time after the disappearance of all other symptoms of gonorrhœa. This Fournier distinguishes from gleet by giving it the name of chronic gonorrhœa.

The form and symptoms of the gonorrhœal attack vary infinitely in different cases. Occasionally the discharge remains as a viscid, clear fluid, and does not become purulent. The inflammation sometimes involves but a small extent of the urethra, and the symptoms do not become severe. In some cases there is profuse discharge and very little pain, and in others much suffering with little, if any, discharge. Some patients recover rapidly from a sharp attack of gonorrhœa, whilst others, notwithstanding care and perseverance in applying treatment, remain subject to a chronic discharge and frequent acute relapses during many months.

There is very little febrile disturbance, as a rule, in gonorrhœa, except the attack be very acute and the patient very feeble, or in cases of serious complication. The painful symptoms of the acute stage cause mental depression and irritability, and the patient suffers from loss of sleep. In cases of profuse and prolonged discharge of pus from the urethra, the patient often becomes slightly anæmic.

As indicated by the sensations of the subject of acute gonorrhœa, the inflammation commences near the external orifice of the urethra, and then spreads backwards towards the bladder, affecting, in its course, the whole extent of the mucous membrane of the straight portion of the penis, but being more intense probably in the region of the navicular fossa. On or about the eighth day, when it may be possible to make an endoscopic examination, the inflammation, according to Desormeaux, has involved the anterior half of the canal, the mucous membrane of which is then red and roughened, and presents superficial ulcerations resembling those formed on the glans penis in balanitis. As the gonorrhœa progresses, the lesion does not change its character but spreads towards the posterior segment of the urethra, involving in succession the bulbous, membranous, and prostatic portions of the canal. Subsequently, as the more severe symptoms of gonorrhœa subside, either the mucous membrane along the whole course of the urethra regains its normal pale colour, or, whilst the anterior and penile portion of the canal and the prostatic portion become quite healthy, the inflammation may persist for some time in the mucous membrane of the membranous and bulbous regions, and there give rise to the granular formations which, in the opinion of Desormeaux and Cruise, constitute the characteristic lesion of gleet.

Complications.—The following are some of the most frequently observed complications of gonorrhœa: phimosis and paraphimosis, due to œdema or serous infiltration, in the one instance of an elongated, in the other of a short prepuce; retention of urine, which, however, is rare except in subjects of organic stricture; follicular suppuration at one or more points of the urethral mucous membrane; circumscribed phlegmon and suppuration of the erectile tissue of the penis; inflammation of the lymph-vessels of the penis, and of the inguinal glands; perineal abscess; inflammation of Cowper's glands; sub-acute inflammation of the glandular tissue of the prostate; congestion or inflammation of the neck of the bladder; epididymitis. The last-mentioned complication presents a transition form between the above group and that of the more remote affections, such as gonorrhœal rheumatism, purulent conjunctivitis, and the so-called metastatic ophthalmia.

Hæmorrhage from the urethra is an occasional complication of gonorrhœa. In the acute stage of a gonorrhœal attack, blood is almost always effused in small quantities, and causes the green staining so often noticed in the purulent discharge. In instances of the rare form of *menstruiform gonorrhœa* described by Ricord, and of extreme congestion of the prostate and neck of the bladder, blood is mixed more freely with the discharge, so as to give it a decided pink or red colour. True urethral hæmorrhage, consisting in a flow of unmixed bright red blood, usually takes place in small quantities, but in some cases is so abundant and persistent as to create anxiety. The cause of this bleeding from the urethra is generally some laceration of the wall of the canal, or rupture of one or more vessels, during severe and sudden chordee. It readily yields, in most instances, to the application of cold cloths to the penis and pressure on the perineum. If very profuse, it may be found necessary to pass a large metal sound along the urethra.

For descriptions of the sequelæ of gonorrhœa, of which gleet, urethral stricture, and chronic cystitis, are the most important, and also of many of the above-mentioned complications, the reader is referred to special articles.

Treatment.— But very little need be said here of the substitutive, or so-called abortive, treatment of gonorrhœa, in which an attempt is made to cut short the attack in its first stage, by setting up, in place of the specific gonorrhœal inflammation, a simple form of inflammatory action readily amenable to ordinary therapeutic means. With this object in view, some surgeons have applied strong solutions of irritants or of astringents to the urethral mucous membrane, and others have administered internally large and frequently repeated doses of balsamic remedies, such as copaiba and cubebs. The free use of balsams is not only useless as a preventive means, but is likely, as has been pointed out by Mr. Henry Lee, to cause much constitutional disturbance; and the local application of nitrate of silver, in strong solution, as recommended by Debeney, Diday and Carmichael, is very liable to result in serious and enduring mischief, and to prove worse than the disease. In the very rare instances in which gonorrhœa is met with while still in the first stage, much good may be done by associating with rest, and a general lowering treatment, frequent irrigation of the urethra with a warm and very weak solution of boracic acid, or of sulphurous acid (♏xv. to f℥j.), or of bichloride of mercury (gr. j. to f℥j.), or one injection daily of a weak solution of diacetate of lead (gr. ij. to f℥j.).

The treatment of gonorrhœa in its acute stage is, in most cases, rendered very difficult simply through the inability of the patient to remain at rest for a sufficient time, or from his disregard of instructions as to diet and general conduct. During this stage, he should, if it be possible, maintain almost constantly the recumbent posture, resting on a hard mattress at night, and on a couch during most of the day. The diet should be low, and consist almost exclusively of milk, eggs, and dry toast. Malt liquors, wine and spirits, and even tea and coffee, must be scrupulously avoided, and the patient should take, when thirsty, barley-water, or some effervescing alkaline drink, as soda, seltzer, or Apollinaris water. The bowels should be promptly relieved by some very active cathartic, and be kept open by a daily morning draught of Epsom salts, or of Pullna or Friedrichshalle water. In the course of the day some alkali should be frequently administered, with the object of reducing the acidity of the urine, and of relieving irritation of the urinary organs. The most effectual of alkaline remedies, during the acute and inflammatory stage of gonorrhœa, are the salts of potash; either the acetate or nitrate, in eight-grain doses, or the citrate in half-drachm doses, may be given with much benefit, every three or four hours, in association with half a drachm of spirits of nitre, and fifteen minims of laudanum or a drachm of tincture of henbane, in one ounce of water.

If the gonorrhœal inflammation be so intense as to cause febrile disturbance, a small draught of five minims of liquor potassæ and two minims of tincture of aconite to a teaspoonful of water, given every hour, will often do much good. If irritation of the genital organs and a constant tendency to erection be the most prominent symptoms of the acute stage, a draught containing fifteen or twenty grains of bromide of potassium, and five minims of liquor ammoniæ acetatis, should be administered every four hours. The patient, unless he be very feeble, should take a warm bath once or twice in the day. The best local treatment, during this stage, is the simple and very useful plan of applying very hot water to the penis.

For the treatment of chordee, many remedies, most of them of very uncertain action, have been recommended from time to time. The most promising is camphor, given at bed-time, in a large dose. Lupulin, bromide of potassium, ergot of rye, belladonna, and opium are each worthy of trial. A very efficacious remedy is a suppository containing a grain of opium and three grains of camphor. In a case of very painful chordee, the best treatment probably, if the patient be strong and vigorous, is for him to have a warm bath just before going to bed, and then, after having taken a drachm of tincture of camphor in an ounce of water, to rest, lying, as far as may be possible, on his side, and very lightly covered.

On the subsidence of the acute inflammatory symptoms, and when the pain, during micturition, has been much relieved, it becomes necessary to vary the treatment. The diet may now be extended, but the patient must still be forbidden to take beer or wine. Continuous rest, also, is no longer necessary, though, of course, active exercise and much standing must be avoided. In this, as indeed in any stage of gonorrhœa, smoking is decidedly injurious, and, as has been insisted on by Dr. Bumstead, entire abstinence, or, at least, much moderation with regard to this habit, should be observed during the treatment.

In dealing with this stage of a gonorrhœal attack, the surgeon trusts mainly to the use, either combined or independent, of balsamic remedies and urethral injections. Of the former agents the best known are copaiba and cubebs. Copaiba is usually given in doses of from half a drachm to two drachms in the form of mixture or pill, or in capsules, and the average dose of cubebs is one drachm. Each of these remedies acts directly on the mucous membrane of the urethra, as it is excreted with the urine, after having undergone some change in the organism. The use of a balsamic remedy is indicated on cessation of pain during micturition, and when urethral tenderness and swelling and congestion of the glans penis have subsided. The selected remedy should be administered regularly, and four times at least in the twenty-four hours; and with respect to meals, one hour before or three hours after each. As a rule these remedies act tardily, and it is necessary, therefore, if no general disturbance is caused by their action, to persevere in their use for several weeks, combining with each, if there be any indications for such agents, tonics or sedatives. There can be no doubt that these remedies, if properly administered at the proper season, are very beneficial agents in the treatment of gonorrhœa; and that failure of a prolonged course of either is generally due to such causes as would neutralize the action of any other method. Copaiba, however, often causes much gastric disturbance and diarrhœa, and occasionally renal irritation: cubebs, it has been stated, may give rise to headache and nervous symptoms, and both remedies are extremely unpleasant to the taste and apt to cause nausea. The most valuable, probably, of the anti-gonorrhœal balsams is the oil of yellow sandal-wood. This is usually more rapid in its action than copaiba, far less unpleasant, and is not so liable to cause nausea or to affect the stomach.

It is very unadvisable to administer any balsam before the acute inflammatory symptoms have commenced to subside, and the remedy should be promptly withheld in case of any relapse during the period of decline. Whether speedy or slow in producing good results, the remedy, if tolerated by the system, should be given for at least a fortnight after the cessation of the urethral discharge. During a balsamic treatment, the patient should avoid taking fluid in abundance, lest the balsam, as it is discharged in the urine, be too much diluted. The agent that is selected, be it oil of sandal-wood, or copaiba or cubebs, if it does not cause any gastric or other disturbance, should be given a fair trial, and it will be found better to give each remedy singly than in combination with either of the others.

The following agents have been given in the third stage of gonorrhœa with such success as to justify a trial of any one in case of failure or contra-indication of the above-mentioned balsamic remedies: turpentine (♏ x.), Canada balsam (gr. v. in pill), infusion of uva ursi (f℥j.), tincture of perchloride of iron (♏x. to xx.), citrate of iron and quinine (gr. v.).

Astringent injections, when used with much precaution, are certainly beneficial in the passive stage of gonorrhœa when all inflammatory symptoms have disappeared. As, however, in the majority of instances, they are liable to be administered irregularly and without proper care, and may excite epididymitis, renewed urethritis and peri-urethral abscess, it will be found advisable, as a general rule, not to have recourse to this method of treatment unless balsamic remedies, after full trial, have failed or proved prejudicial. As some of the most useful of the many agents that have been used in injections may be mentioned: nitrate of silver (gr. ij. to f℥viij.), sulphate of zinc (gr. j. to f℥j.), chloride of zinc (gr. j. to f℥j.), sulpho-carbolate of zinc (gr. ij. to f℥j.). A very useful injection is that known as Ricord's combination of sulphate of zinc and actetate of lead (gr. v. of each to f℥j. of water).

The urethra having been injected with warm water, and the purulent discharge washed away, about half an ounce of the astringent injection should be slowly introduced, and be retained in contact with the urethral mucous membrane for about five minutes. Two, or, at the most, three injections should be given in the twenty-four hours. During a course of treatment by injection, the patient should take care to avoid irritating the genital organs by active exercise, imprudence in diet, or sexual excitement. If blood appear in the discharge, or micturition become frequent and painful, the use of injections should at once be discontinued.

An antiseptic treatment, based on the assumption of a parasitic origin of gonorrhœa, has been strongly advocated by Mr. Watson Cheyne, who recommends the use of soluble bougies containing eucalyptus and iodoform, with a view of arresting, or at least checking, the acute inflammatory symptoms. W. Johnson Smith.

GONORRHŒAL EPIDIDYMITIS. *See* Testis, Diseases of the.

GONORRHŒAL OPHTHALMIA. *See* Conjunctiva, Diseases of the.

GONORRHŒAL RHEUMATISM is an inflammation of the joints or fibrous structures, dependent upon discharges from the genito-urinary organs. The most frequent cause is gonorrhœa, which may be in the acute or chronic stage. The disease may also be set up by any form of urethritis, or even by a balanitis, and in women a closely allied condition is apt to accompany obstinate leucorrhœa. In infants, as Mr. Lucas has recently shown, ophthalmia neonatorum may give rise to a similar affection. There are three well-marked varieties of this disease—viz. (1) an acute, (2) a chronic inflammation of the joints, and (3) an inflammation attacking non-articular fibrous tissues.

Symptoms and cause.—1. The *acute articular* form begins with slight feverishness and pains in several joints, which are somewhat swollen and tender. In a few days the inflammation appears to concentrate itself upon one of these joints, while the others recover. The swelling and tenderness increase; the tissues covering the joint and the adjacent parts of the limb become œdematous, and the skin is often reddened. There is acute pain, which is much increased by any attempt to move the limb. The tenderness is especially noticeable when pressure is made upon the stronger ligaments of the joint. Thus, when the elbow is attacked, the parts below the condyles of the humerus are excessively sensitive on account of the inflammation in the lateral ligaments. There is usually some serous effusion into the synovial cavity. The joints affected are almost invariably the larger ones, and especially the elbow and wrist. The patients are usually young adults, and the writer has seen more instances of the affection in women than in men. The discharge from the genital organs may be slight, or even a mere gleet. It does not appear to be diminished or otherwise affected by the outbreak of the joint-inflammation. The temperature is usually but little raised, and there is not much constitutional disturbance. The patient, however, is often anæmic and feeble, and the local pain, by interfering with his appetite and sleep, is apt to increase this debility. In the great majority of cases the disease gradually subsides, and leaves the joints in a more or less rigid condition. In rare instances the joint may suppurate and become disorganised. Occasionally other joints are successively attacked. The disease may recur with a subsequent gonorrhœa.

2. A *chronic articular* form of the disease is perhaps not more frequent, but it is certainly more often recognised. It appears as a sub-acute inflammation of the synovial membrane, which attacks especially the knee and ankle-joints of men. There is serous effusion into the synovial capsules, without any redness of the skin or superficial œdema. The pain is of a dull aching character, and does not prevent the patient getting about, in a more or less crippled condition. Two or more joints are often simultaneously affected. The disease is very obstinate, and it is liable to frequent exacerbations. It never suppurates.

3. A chronic or, in rare cases, an acute inflammation may attack the *non-articular* fibrous tissues, such as the fasciæ of the muscles, the annular ligaments, the sheaths of nerves, &c. It is attended by some swelling and tenderness, with severe pain in the affected structures, which are sometimes so softened as to allow of considerable yielding. Thus when the plantar fascia is attacked, the arch of the instep may fall in, and a flat foot may be produced. The sclerotic coat of the eye may be the seat of such an inflammation, indicated by a peculiar congestion which may accompany the acute or chronic form of joint-disease. Occasionally also the fibrous tissues of the heart are attacked, and valvular lesions have followed this complication.

Pathology.—The disease is probably of a pyæmic character, depending upon the absorption of inflammatory products from the genito-urinary tracts. Some writers, however, have attributed it to innervation, and have considered that the inflammation is set up by reflex action of the nerve-centres under the stimulus of the local irritation. In the acute form of joint-disease the fibrous tissues are especially affected, and they are frequently so much softened as to permit of abnormal movements. There is often fibrinous exudation within the articular cavities, and the cartilage may be eroded, so that a rough or even grating sensation may be felt upon moving the joint. Adhesions are also formed in the peri-articular regions, and in the sheaths of the adjacent tendons.

The more chronic form appears to affect the synovial membrane, without any serious implication of the other structures of the joints.

Diagnosis.— The chronic forms are easily recognised. They resemble gouty or rheumatic synovitis, but the presence of the urethral discharge suffices for their discrimination. The acute form is at first very like a mild attack of rheumatic fever. Afterwards, when one joint is alone affected, it may assume an appearance similar to that of phlegmonous erysipelas, phlebitis, or acute suppuration of the joint. The discharge from the genital organs may be slight, and there is usually a disposition to conceal its presence. From overlooking this symptom serious mistakes have often been made. Frequently the red and swollen tissues have been incised under the idea that pus has formed. It is therefore wise in all cases of acute idiopathic inflammation of a single joint to examine into the condition of the genito-urinary organs.

Treatment.—By the use of astringent and soothing injections the urethral or vaginal discharge should be cured. In the acute form the joint should be kept at perfect rest, with gentle pressure and some anodyne application. Lint spread with a mixture of equal parts of ung. hydr. comp. and extract of belladonna should be wrapped round the joint, and a plaster of Paris bandage applied over all. As ankylosis may occur, the joint should be placed in the most useful position. As soon as the acute symptoms have subsided passive motion should be employed, and the still swollen joint should be supported by an india-rubber bandage applied over the greater part of the limb; or the limb should be swathed with five or six layers of cotton-wool, and then firmly compressed by a starch bandage. In the more chronic form this latter treatment is also beneficial, as it permits the patient to move about freely and to follow his ordinary occupation. Blisters or stimulating liniments may often be required for the cure of this obstinate form of the complaint. When the pain is severe the local application of some anodyne, such as the extract of belladonna, may be necessary.

Attention should be paid to the general health. A nutritious diet should be given, and the bowels should be relieved by gentle purgatives. But little benefit is obtained from the use of alkalies, iodide of potassium, salicylate of soda, or the other remedies for rheumatism. Some tonic preparation, such as a combination of quinine and iron with mineral acid, is usually more beneficial.

N. Davies-Colley.

GOOCH'S SPLINT consists of flat boards, about one-eighth of an inch thick, glued on to oilcloth or leather, and split into parallel strips about one-third of an inch wide by longitudinal incisions, which do not completely divide them. It is flexible in one direction and quite rigid in the other. It is a very useful material to have at hand for extemporising splints from, as it can be readily cut to the required shape and size with a knife. Its transverse flexibility renders it most comfortable to the patient, whilst its longitudinal rigidity fulfils the needs of the surgeon. It is the best material for stump-splints and short thigh-splints for fractures of the femur treated by simple extension; but it may be used, and is by the Scotch surgeons, for almost all regions.

Bilton Pollard.

GORDON'S SPLINT FOR COLLES' FRACTURE consists of an anterior splint, to the radial side of which is fixed a wooden pad shaped so as to fit the concavity at the lower end of the radius. From the lower end of the splint there is a prolongation adapted to receive the ulnar border of the hand in the adducted position. There is also a slightly hollowed dorsal splint, which is placed over the back of the forearm and dorsum of the hand.

Bilton Pollard.

GORDON'S SPLINT FOR FRACTURED CLAVICLE consists of a body-plate and an artificial clavicle or rod passing from it to a front arm-splint; to the anterior border of the latter a second arm-splint is attached. The splints are fixed in position by a complicated system of straps. The objects of the splints are to rotate the shoulder outwards and backwards, and maintain it in that position until union of the fracture has taken place. No attempt at elevation of the shoulder is made, as the author of the splint considers that the shoulder is not really depressed, and that pushing the shoulder upwards, backwards, and outwards would increase the deformity.

Bilton Pollard.

GORGET. *See* Lithotomy.

GRAFTING.—Skin-grafting.—Many large granulating surfaces, though at first healing with considerable rapidity, afterwards do so slowly, and the process may even come to a standstill owing to the resistance of the surrounding tissues to the further contraction of the granulations, and also probably on account of the attenuated condition of the epithelial cells at the border of the sore. In such cases in time past, flaps, including the entire thickness of the skin, were occasionally taken from another part of the body, and placed on the granulating surface; but this process, besides being painful, and leaving a large sore at the spot from which the flap was removed, was in so many instances attended with failure, that it was seldom resorted to. M. Reverdin of Geneva introduced the present method of skin-grafting. In 1869 he succeeded in transplanting small portions of skin from one part of a man's body to a granulating surface situated at another, and thereby greatly hastened the healing of the sore. This method has been widely adopted, and is now regularly employed to facilitate the healing of large granulating surfaces, such as may have been left by ulcerative processes, occasioned by large burns or by wounds involving an extensive destruction of the cutis. It is also of considerable value in obviating deformities, such as ectropïon arising from contractions due to cicatrisation.

A granulating surface is covered with epithelium by segmentation or budding of the epithelial cells at the margin of the sore. These cells cannot arise from granulation-tissue, but must have origin in some pre-existing epithelium. If then minute portions of skin be transplanted on the granulation-tissue, the proliferation of the cells of these grafts leads to the formation of cuticular islands, which go on increasing until they coalesce with one another, or with the epithelium from the margin of the sore. By doing so the healing is greatly facilitated, and the process of repair is rendered much more complete and permanent.

The transplanted graft ought to consist of some of the protoplasmic cells of the rete. The Malpighian layer is supposed to be necessary, but any of the cells of the stratum granulosum, and even the deeper cells of the stratum lucidum, the writer considers quite sufficient for the purpose. The stratum cornium is of no value; neither does it serve any purpose, if indeed it does not hinder the process, to include the subcutaneous tissue. Practically, all that is necessary is to remove a minute superficial portion of the skin. This may be done in a variety of ways. The dissecting-forceps may be made to pinch up, or a needle to transfix, a small portion of the skin, which may be snipped with scissors or removed with a scalpel. A special instrument, a combination of scissors and forceps, is made by Krohne after Macleod's pattern, for effecting the removal of such portions of skin. The writer finds that a pair of sharp scissors curved on the flat is well adapted for raising a thin shaving of the cutis. The surface from which the skin is removed presents a reddened appearance, with at times a few minute points of blood. It may be covered for a few days with a small portion of protective oiled silk or other simple dressing, or better still dusted with iodoform, which stops the bleeding and acts as a good dressing.

When the portion to be grafted has been elevated, it is divided into as many minute particles as practicable: pieces the size of an ordinary pin's head are suitable. This may be done by means of a sharp knife, the finger-nail being used as a table. These grafts may be placed at any part of a healing granulation-surface, and may grow there, forming islets of skin. But all parts of a granulating sore are not equally prepared for the reception of a cuticular covering. Thus, at the centre of a healing sore the granulations are prone to be larger and the secretion more profuse than towards the margin, where they are at the proper level of the skin, and where the secretion is reduced to a minimum. Therefore if the grafts are placed within three-quarters of an inch of the margin of the ulcer, they will find a tissue suitable for their reception. They may be placed about an inch apart from each other. Not only is this zone of tissue more suitable for the grafts, but by their presence here, they seem to exercise a beneficial influence on the cutis at the margin of the sore itself; as, shortly after the grafts have become adherent, the marginal epithelium seems to be stimulated to more vigorous growth than formerly. The grafting may be repeated as often as required.

The grafts ought to be placed in intimate contact with the granulation-tissue, and retained in position by some convenient dressing. Some surgeons recommend that a wound be made in the granulation-tissue, and that the grafts be inserted into it. This is not advisable, but care is required to prevent the grafts from being displaced, which may happen in one of two ways: first, by friction from the outside, and, secondly, by being floated from the granulations in the discharge. The means taken to obviate the former often facilitate the latter. If the sore be large, and a single piece of guttapercha tissue, or other waterproof material, be laid over the grafts in contact with the granulation-tissue, the secretion from the whole surface accumulates under the dressing, and is apt to float the grafts before they have become sufficiently adherent. The writer finds that a piece of freely perforated oiled silk or protective plaster, laid on the grafts and covered with sublimated wood-wool, is admirably suited for the purpose. The silk protects the grafts from injury, and as it does not adhere, there is no tendency to displacement of the grafts, while the numerous apertures in the oiled silk permit the secretion to come into contact with the sublimated wood-wool, which, being an excellent absorbent, the wound is kept dry, the necessity for frequent dressing is dispensed with, and the healing is facilitated. A week afterwards the wound may be dressed.

The superficial layer of the grafts sometimes separates, and is seen floating in the secretion while the deeper layer has united to the tissues. If this be not borne in mind when the surface of the granulation-tissue is being examined in order to ascertain whether the grafts have taken, it might lead one to suppose that they had failed. This mistake is all the more probable on account of the fact that the young epithelial cells are so transparent that they are barely recognisable, the granulations being seen through them, and therefore at an early stage they might be easily overlooked. The newly transplanted skin assimilates itself so thoroughly to the tissues that it soon becomes sensitive, and the cicatrix formed by its aid resists disintegrating changes much better than when unaided cicatrisation has taken place over a large surface.

In dealing with ulcers it is essential that all molecular disintegration should have ceased at the part on which the graft is to be placed. Occasionally skin-grafts do succeed when planted on granulations which are not quite in a state of health, and when this is accomplished they speedily effect an improvement on the granulations surrounding them. Though this be admitted, there can be no doubt that skin-grafting is most easily effected, and most successful when performed on a healthy granulating surface. As the condition of the ulcer depends greatly on the state of the patient's constitutional condition, the general health ought to be closely looked to.

The parts of the body from which grafts ought to be taken are those least exposed to friction, and which are at the same time not covered by a thick cortical layer. It is best to take the graft from the body of the patient for whom it is required. By doing so, the fear of introducing deleterious or poisonous elements into the blood is avoided. A mother might prefer to have the graft removed from her own arm for the sore on her child. If the graft is to be removed from another person, sanction ought to be sought and distinctly received before doing so. Although the epithelium is being constantly renewed during the whole life of the individual, yet in old age its vitality is somewhat impaired, and it is not so suitable for grafting as that of a young person. In a hospital, skin may be taken from a newly amputated limb—the sooner after removal the better, though the epithelium has been known to have retained its vitality for an hour after amputation, and to have lived on being grafted.

Transplantation of conjunctiva has been frequently successful. The transplants have been taken from the conjunctiva in the lower animals, and applied to the eyeball in man. The epithelium from the mucous membrane of the lip has been likewise used for this purpose, it is said with success. The cornea has been in a few cases transplanted; on one occasion at least it has been temporarily successful, the part remaining transparent for a considerable period, and only becoming opaque afterwards from an inflammatory attack.

Muscle and nerve have been transplanted, but the data given are not sufficient to warrant any practical deductions therefrom.

BONE-GRAFTING.—Under this heading some include several distinct processes, re-implantation of bone, osteoplasty, and bone-grafting. The first of these consists in the replacement in its original position of a portion of bone temporarily removed by operation or by accident; such as the reimplantation of a disc of bone elevated by trephining the skull. In osteo-plastic operations, a portion of bone is detached, so that its osseous continuity is either wholly or partially severed, while its attachment to the soft parts from which its vascular supply is derived still remains more or less complete. This is illustrated when one endeavours to fill up a deficiency in a long bone by detaching and shifting a portion of bone from the shaft in the immediate vicinity of the gap, while a pedicle of periosteum, or of the soft tissues, is left adherent at one extremity of the detached portion of bone. Neither of the foregoing should be properly included under the heading of bone-grafting, that term being reserved for such operations as involve the introduction of a portion of bone into the tissues altogether removed from its original seat, or of transplantation of osseous tissue from one animal to another.

Though in times past many attempts have been made to graft bone, or some of its elements, they have not been attended with practical success until within recent years. In a paper published in the *Proceedings of the Royal Society* in May, 1881, entitled 'Observations concerning Transplantation of Bone,' the writer referred to a case which he had of successful and extensive bone-grafting. The grafts in this instance were obtained from six limbs of three children who had to be operated on for tibial anterior curvatures, and a wedge of bone was removed from each limb. The grafting was performed on three separate occasions, two wedges being transplanted at one time. These wedges were divided into minute fragments, irrespective of periosteal attachments, and were placed in a sulcus made between the humeral muscles of a boy who had lost his humeral diaphysis more than a year previously. By these numerous grafts the two epiphyses were united together by a firm shaft, and the use of his arm was fully restored.

It is stated that bone cannot be transplanted from one species to another, and though definite proof to the contrary is wanting on this point, the writer has reason to doubt the accuracy of the statement. The best osseous grafts are obtained from young growing bone. Human bone may be obtained in hospitals from limbs which have been removed on account of accident or disease. In cases of anterior curvature of the tibia, causing marked deformity, and which demand straightening, it is often necessary to remove a wedge therefrom, and such wedges may furnish the material for grafting. The preservation of the periosteum is not essential to the success of the graft; it is important to preserve it, however, owing to the fact that in young bone it protects the underlying osteoblasts, and forms vascular connections with the tissues into the midst of which it is transplanted. Many portions of bone, even of the deeper layers, and those occupying a position midway between the medulla and the cortical substance, grow well when transplanted. After removal of the bone, it ought to be divided into minute fragments about the size of a pea. In doing this the fragments ought not to be broken or crushed, but cleanly cut. If the bone about to be taken for the graft be thin and vascular, it may live and grow in its transplanted situation without having been so minutely subdivided. Discs removed from the skull, when they are young and vascular, have grown when reimplanted after operation.

When an osseous graft is about to be effected, the part into which the graft is to be placed ought to be first prepared. The extremity of the bone, to which the graft is to be attached, ought to be refreshed, and the aperture between the muscles made of sufficient size to receive the osseous fragments without over-distension. After all bleeding has ceased, the part is ready for the reception of the grafts. The portion of bone to be transplanted ought then to be struck out of its normal position with a sharp chisel, and cut into small pieces, immediately thereafter placed in the sulcus prepared for it, and the soft parts closed over it. The entire operation ought to be performed under strict antiseptic precautions. The limb ought then to be fixed and kept at absolute rest. If healing by first intention is obtained, the parts ought to be tolerably firm at the expiration of a month, though it is better to maintain complete rest for six weeks or two months from the date of operation. On this point, however, something will depend on the extent of the graft employed, a small one becoming firm sooner than an extensive one. If suppuration follows, some portion of bone will be thrown off, and if the inflammatory process be great the whole graft may be shed. One of the chief points in securing success is obtained when the wound heals without suppuration.

The grafting of periosteum and of the medulla of bone have both been experimentally successful in the lower animals; but the data derived from these observations are neither so clear as to warrant definite conclusions being formulated from them, nor sufficient to establish their practical utility. It is difficult to see in what way either of these elements would equal the efficiency of bone-grafts for practical purposes.

SPONGE-GRAFTING.—With a view of expediting the healing of deep wounds in which there has been a loss of tissue, Dr. Hamilton of Edinburgh introduced the practice of what he called 'sponge-grafting.' The sponge to be used is previously prepared by steeping it in dilute nitro-muriatic acid, to dissolve the silicious and calcareous salts; and when this has been effectually accomplished, the sponge is washed in dilute ammonia or potash, to remove all excess of acid. It is then placed in a 5 per cent. solution of carbolic acid, to render it aseptic, and it is stored in the same until required. A thin section of sponge prepared in this way, Dr. Hamilton recommends to be placed over such granulation-surfaces as are below the level of the skin, with the view of affording a support for the blood-vessels of the granulation-tissue which would push their way into the interstices, and so fill up the cavity, the sponge eventually becoming absorbed. He further recommends that, when one piece of sponge has been covered by granulations, another may be applied on the surface until the granulation-tissue reaches the proper level. Dr. Hamilton relates cases in which he believes that this process hastened the healing of the sores, and a few cases have been reported by other surgeons, all of them tending to prove that the so-called 'sponge grafting' is a successful means of healing such sores. The writer has carefully experimented in this direction, and, however interesting as a physiological phenomenon the penetration of the decalcified sponge by granulation-tissue may be, his observations have not led him to believe that the sponge hastened the healing of the sore, while in some instances it distinctly retarded it.

William Macewen.

GRANULAR OPHTHALMIA. *See* Conjunctiva, Diseases of the.

GRAVES' DISEASE. See *Exophthalmic Goître*, under Thyroid Gland.

GREENSTICK FRACTURE. *See* Fractures.

GROIN.—The groin is the site of many important injuries and diseases, forming as it does the junction of the abdomen, pelvis, and thigh; and being the seat of four forms of hernia—inguinal, femoral, obturator, and ventral—and of many varieties of abscess and tumour.

Stretching between the anterior superior spine of the ilum and the pubic spine is Poupart's ligament. Below this is a hollow, corresponding superficially to Scarpa's triangle in the dissected part. Beneath the ligament is the pubic bone; and between the two, passing from the abdomen to the thigh, are the psoas and iliacus muscles; the femoral artery and vein; the anterior crural, the crural branch of the genito-crural, and the external cutaneous nerves.

Deeper than the horizontal ramus of the pubic bone, and under the pectineus muscle, is the opening whence obturator hernia escapes from the pelvis. Above Poupart's ligament is the inguinal canal, with the internal ring half an inch above the middle of Poupart's ligament, and the external ring above and internal to the pubic 'spine.' The femoral ring is immediately below and external to this bony process. The inguinal canal is concerned in hernia, various forms of hydrocele, undescended testicle, misplaced ovary, varix and fatty tumour of the cord. The superficial fascia over the groin is disposed in two layers—the subcutaneous fatty, and the deeper membranous, the latter being firmly attached to Poupart's ligament.

An inch and a half below and external to the pubic spine is the saphenous opening. The crural sheath has three compartments: the outer, lodging the femoral artery; the middle one, the vein; and the innermost—called the crural canal—a pellet of fat and a lymphatic gland. Femoral hernia occupies the last-named space. Between the layers of the superficial fascia are some blood-vessels, and lymphatic glands and vessels. The lymphatic glands of the groin are arranged in two primary sets, superficial and deep. The former consist of a horizontal series along Poupart's ligament, and a vertical in Scarpa's triangle. The deep set lie in the crural sheath beside the vein. A bursa lies between the ilio-psoas muscle and the capsule of the hip-joint. It may communicate with the synovial membrane of the articulation.

In the diagnosis of diseases and injuries of the groin it is important to determine whether the lesion is entirely confined to the part, or is connected with some other region either by continuity of solid tissue, by lymphatic vessels, or by a wider channel, as in psoas abscess and hernia. Immediate localisation is a further aid in estimating the nature of a given case; thus, a swelling above Poupart's ligament is suggestive of an enlarged gland, an undescended testicle, funicular hydrocele, and thickening of the cord.

Isolated nodular elevations of the skin indicate enlargement of the subjacent lymphatic glands. Nodulation *en masse* points to a conglomeration of swollen glands, or to a lobulated tumour.

Congestion of the skin shows that the circulation in it is impeded. If the redness is diffused, it may be concluded that the morbid process has involved the skin. Distension of the cutaneous veins proves that there is deep-seated obstruction from compression or plugging of blood-vessels.

Flexion of the thigh is common to all painful affections of the groin. *Fixed rigidity* in this position is generally due to hip-joint disease, or deep-seated suppuration from any other source; it shows that the soft parts have undergone atrophic shortening. *Transient flexion* is entirely owing to spastic contraction of the muscles. Taken alone it is of little use in diagnosis, as it may be caused by a variety of pathological states. It disappears under the influence of an anæsthetic.

A pulsating tumour in Scarpa's triangle is probably an aneurism, or a vascular malignant growth; possibly a solid or fluid swelling, with pulsation communicated from the femoral artery.

If the tumour, after being emptied by compression, refills suddenly with a thud, and the bruit, when present, is conducted for some distance along the main artery, and the pulsation is markedly expansile, it is an aneurism. But when an aneurism is largely filled with clot, especially if it has ruptured, and the swelling is thereby more diffuse, its density is greater, whilst the bruit and thrill may be abolished and the pulsation reduced to a minimum. Attention must then be directed to the previous history of the case. The pulsation of a malignant growth is constant and progressive. Dilatation of other arteries would afford a strong presumption in favour of aneurism.

Dilatation of the superficial veins, with pulsation, bruit, and thrill, are the signs of *arterio-venous aneurism.*

A swelling which has previously pulsated, and subsequently become red and painful, is probably an *aneurism with inflammation or suppuration about the sac.* It must not be mistaken for an abscess with communicated pulsation. To avoid this, the various sources of abscess-formation should be carefully explored.

A non-pulsating, reducible swelling, giving an impulse on coughing, is either hernia, abscess—psoas, e.g.—or varix. If it is resonant on percussion, elastic, and *suddenly* reducible under pressure, it is *hernia.* The exact nature of the rupture is told generally by the situation of the swelling, and especially by the position of its neck. Thus if the hernia be limited above by Poupart's ligament, it is either femoral or obturator; if bounded below by that structure it is inguinal or ventral. The elasticity and resonance on percussion differentiate an inguinal hernia confined to the canal, from an enlarged gland or swollen undescended testicle; whilst resonance on percussion and sudden reduction by pressure distinguish it from encysted hydrocele of the cord. If the neck of the hernia lies immediately above and internal to the pubic spine, the rupture is inguinal. The neck of a femoral hernia is situated just outside and below the pubic spine. It is very important to note this fact, because it is not uncommon for a femoral hernia, after it has escaped from the saphenous opening, to turn upwards over Poupart's ligament and so simulate an inguinal rupture. In such cases the swelling passes outwards as a rule, but it may travel inwards and completely overlap the external abdominal ring.

Roundness of contour is suggestive of a femoral hernia, whilst an oval outline is presumptive evidence of a bubonocele.

A small, hard, tender, and painful swelling, at the site of the crural canal, is either an *inflamed lymphatic gland* or *a femoral hernia.* Palpation alone may fail to distinguish them. The signs of incarceration or strangulation—pain in the belly, vomiting, and obstruction of the bowels—when present suffice for the diagnosis, but they may be imperfectly developed and thus equivocal. Then, in the absence of enlargement of contiguous glands, the part must be cut down upon and recourse had to direct inspection.

A lobulated painless swelling, devoid of impulse on coughing, and possessed of considerable solidity, is probably *a fatty tumour.* A femoral epiplocele is usually painful on manipulation.

A slight fulness in Scarpa's triangle, accompanied by pain referred to some part of the obturator nerve, and by the symptoms of obstruction of the bowels, points to *obturator hernia.* The absence of swelling does not negative the diagnosis, for, in the majority of recorded cases, the existence of a tumour was not ascertained during life. A careful comparison of both limbs should be made, and the pelvis examined per rectum or per vaginam, and, if necessary, the obturator foramen must be explored—by incision through the thigh, or by opening the abdominal cavity.

A resonant swelling, which expands and becomes more tense on coughing, situated above Poupart's ligament, but not occupying the inguinal canal, is a *ventral hernia.* The history of the bursting of a pelvic abscess, or of ligature of the external iliac artery, the presence of a cicatrix, and the condition of the femoral artery, afford corroborative evidence.

A soft swelling at the upper and inner part of the thigh—one which diminishes in size or disappears without gurgle or slip on elevation of the limb, and on the application of slight pressure—which returns of itself when the limb is pendent, even though compression be maintained over the crural ring and psoas tendon, is *varix of the saphenous vein.* The tributary branches are usually much dilated.

As regards the degree of impulse on coughing, it may be said that it is most forcible in hernia and least in varix. It varies in different cases of reducible abscess, according to the consistence of the pus and the width of the neck beneath Poupart's ligament. In some it is quite manifest, in others it is difficult to obtain.

The tumour is *solid, non-pulsating, and irreducible.* It probably consists of (1) enlarged lymphatic glands, (2) some form of new-growth, or (3) an undescended testicle.

If the swelling is multiple, and situated along Poupart's ligament, or in the course of the femoral vessels, it is *glandular* in nature. Then, if no lesion exists in the associated lymphatic vessels, the enlargement is almost certainly owing to some constitutional state — syphilis (excluding local infection), scrofula, or Hodgkin's disease.

The history of past infection, and the existence of other signs of syphilis, afford the required corroborative evidence on this head. The youth of the patient, and the past or simultaneous affection of other tissues, such as caries of bone, joint-disease, &c., point to *scrofulosis.*

If the tumour is of considerable size, and other groups of glands—axillary, cervical, &c.—are affected, it is a *lymphadenoma.* Excess of leucocytes in the blood and increase of the splenic dulness confirm the diagnosis. Suppuration and peri-adenoid induration are most marked in scrofula, least in lymphadenoma. Strain is not an infrequent cause of swelling of the inguinal glands.

If irritation of the peripheral lymphatics is discoverable, the glandular swelling is termed a *bubo.* This is said to be *sympathetic* when it is consecutive to acute inflammation, as from a chancre or a heel-gall, is accompanied by pain and tenderness, and shows a tendency to suppurate. Hard, painless, freely-movable glands constitute *indolent bubo*; and, from their prevailing size and shape, they are termed *amygdaloid.* The glands are welded into a confused mass from perilymphatic exudation. They are breaking down at several points, and the subject is of strumous habit. This is *scrofulous bubo.*

Cancerous disease—e.g. epithelioma of the penis or scrotum—is propagated, sooner or later, to the glands next in order; it also gives rise—notably when ulceration has commenced—to simple irritative enlargement. The differential diagnosis of the two conditions in the early stage is difficult. If removal of the primary growth is followed by marked subsidence of the sympathetic swelling it may be concluded that the latter is benign; if, on the other hand, the glands are very hard, massive, and a portion of it ulcerated, *the bubo is malignant.*

The *non-glandular solid tumours* of the groin include lipoma, osteoma, enchondroma, carcinoma of the skin, and malignant connective-tissue tumours, either purely sarcomatous or composite—e.g. myxo-sarcoma, osteo-sarcoma, &c. The special features of each are given fully elsewhere. If the tumour is freely movable, of doughy consistence, and lobulated, it is a *lipoma*; and the diagnosis is all the more certain if it is found that the growth has travelled from its original position. Or, the tumour is very hard, perhaps distinctly lobulated; it is fixed to the epiphysis of the femur or to the pelvis, either at the symphysis or sacro-iliac synchondrosis. It is an *enchondroma*, or, less probably, an *osteoma.*

Enlargement and rigidity of a muscle or tendon, especially near its attachment, is probably owing to ossification from strain. The adductor longus is peculiarly prone to this change. *See* RIDER'S BONE.

There is a swelling at the site of the inguinal canal; it gives the 'testicular sensation' on pressure, and the testicle is absent from the scrotum. It is a case of *undescended testicle.* Its solidity and want of translucency distinguish it from *encysted hydrocele.* The absence of impulse on coughing, and of resonance on percussion, prevent its being mistaken for *bubonocele.* Partial descent of the testicle predisposes to hernia; it is important, therefore, to bear in mind the possible association of the two.

A swelling in the groin which is marked by enlargement and accession of pain at the menstrual period, is very likely to be due to an *ovary* occupying the inguinal canal.

Several fluid tumours remain for consideration, viz.:—I. Cysts. (α) Enlarged bursa; (β) sebaceous tumour; (γ) encysted hydrocele of the cord; (δ) hygroma; (ϵ) hydatid cyst. II. Diffuse hydrocele of the cord. III. Effusion into the hip-joint. IV. Abscess.

If the tumour is situated over the hip-joint, and it is rendered more painful by abduction and extension of the limb, but not by percussion of the heel or great trochanter, it is probably caused by effusion into the *bursa* between the capsule of the hip-joint and the psoas tendon, and not by distension of the articular capsule.

A *sebaceous tumour* simulates chronic abscess and lipoma. To differentiate them, it must be ascertained if the swelling is lobulated, and the signs of local inflammation and the causes of glandular abscess must be looked for. In case of doubt a trocar and canula should be used.

A small tense and elastic swelling in the inguinal canal, which is possibly fluctuating and translucent, and is without resonance on percussion or impulse on coughing, is an *encysted hydrocele of the cord.* It has to be diagnosed from bubonocele, hernia, and undescended testis.

If the tumour dates from birth, and yields a clear lymph on puncture, it is a *congenital hygroma.* It may be purely cystic, or partly cystic and partly solid. It may be soft and puffy to the touch, or more or less tense and elastic, and its outline may be distinct and even, or indefinite and irregular.

If the tumour is marked by chronicity and painlessness, and the fluid drawn from it is clear, of low specific gravity, and free from albumin, it is an *hydatid cyst.* The finding of hooklets, echinococci, or secondary cysts in the fluid, settles the diagnosis.

Diffuse hydrocele of the cord may be reducible or irreducible. If reducible, the fluid flows steadily back under pressure; there is not the slip or gurgle as in reduction of a hernia. If irreducible, it is marked by fluctuation, absence of resonance, and possibly by translucency.

The chief varieties of *abscess* in the groin are—(1) Lymphatic and perilymphatic; (2) Psoas and iliac, including perityphlitic and perinephritic; (3) Articular and extra-capsular. Some of these are acute, others chronic. The majority of the first group are consecutive to irritation in the corresponding lymphatic areas.

If the tumour is reducible, and continuous fluctuation can be obtained above and below Poupart's ligament, whilst the spine shows angular curvature, it is an ordinary *psoas abscess.* There may be one on each side, and the two may communicate across the bodies of the vertebræ.

An *iliac abscess* may originate in the fossa of the same name, in the true pelvis, or about the kidney. These regions should be carefully explored. *A pericæcal abscess* is usually accompanied by the symptoms of obstruction of the bowels, and is commonly due to fæcal impaction.

It is difficult to diagnose with certainty suppuration within and immediately without the hip-joint. Pain on passive movement and percussion is generally greater in the former case.

Augustus J. Pepper.

GUINEA-WORM. *See* Filaria Medinensis.

GUM-BOIL.—This is an inflammation, usually running on to suppuration, about the apex of the root of a tooth, which comes to be enclosed in an abscess sac adherent to it at a little distance from its end. The pus from this abscess is very often evacuated through the pulp-canals, the pulp being almost invariably dead and decomposed in cases of gum-boil; but there is always some inflammation of the bone and periosteum overlying it, and if the exit *viâ* the pulp-chamber is not very free, the pus eats through the alveolar plate and appears on the surface of the gum, with more or less swelling; hence the name gum-boil.

The cause of the inflammation is, in the vast majority of instances, the escape from the pulp-chamber of the products of the decomposition of the pulp or of other matters which have found their way into the vacant pulp-chamber, thus making a poisoned wound at the apex of the root. The amount of pain and disturbance is pretty directly proportionate to the degree of confinement of the inflammatory products, so that the first thing to be done in the way of treatment is to open the tooth up freely and syringe it out, so as to enable the pus to well up through it, and to lance the gum deeply if it be much swollen. A gum-boil is in the best position for healing when there is an exit by way of the gum as well as through the root-canals; and if several drops of creosote, or other powerful antiseptic, can be pumped in through the tooth so as to find its way out through the opening on the gum, the abscess will usually heal immediately. When the inflammatory state has quite passed off, the tooth should be sealed, so as to prevent the access of foreign matters by way of the pulp-canals; but it is not enough merely to fill the cavity of decay, the root-canals must also be solidly filled or the abscess will soon recur, perhaps from the accumulation of serum in the canals and its subsequent decomposition.

If left to itself, relief is afforded by the escape of the matter, which from time to time re-forms, and a permanent fistulous opening remains in the gum; ultimately the end of the root becomes rough and more or less absorbed, so that the tooth gets loose. When the roots of a tooth are so long as to reach beyond the reflection of the mucous membrane on to the cheek, there is much more danger of the abscess bursting on the cheek or beneath the chin. If this threatens, every endeavour should be made to get a free opening through the tooth, and the skin should be supported by painting with collodion, &c.; it need hardly be said that under no circumstances should a poultice be applied externally, though a small bread poultice laid in between the cheek and the gum is soothing and useful. Slight degrees of inflammation, short of suppuration, may be treated by painting the gums with iodine, or with tincture of aconite; sometimes a mixture of these in equal parts is applied with benefit.

In cases of exceptional severity, necrosis of portions of the alveolar processes may ensue; or suppuration of the lymphatic glands; or pus may burrow down the neck; or enter the antrum, and set up suppuration there. Pyæmia and death have occasionally resulted from Alveolar Abscess.

Charles Tomes.

GUMMA.—It might be well perhaps that this term should pass out of surgical use, for it is exceedingly difficult to define it or to state to what conditions it should be restricted. Conventionally, it is used for any chronic swelling occurring in connection with syphilis. Formerly its use was limited by many to tumour-like indurations occurring in the cellular tissue and viscera in the tertiary stage; but it is now not infrequently applied to papules and tubercles developed in the skin at much earlier periods; and histologists can draw no line of distinction between the chronic sclerosis which attends the primary lesion of syphilis and those of its later stages.

A gumma, it may be said, always begins in cellular tissue, and is always slow in its development. In its later stages it is often attended by inflammation, which may cause the skin to give way over it, and may expose a mass of sloughy tissue which has aptly been compared to sodden wash-leather. In degree of hardness gummata vary very much, and the close similarity to new growth which they sometimes present is such as to make diagnosis very difficult. The certainty and rapidity with which they yield to the use of iodide of potassium are, however, such that the diagnosis and cure are not infrequently simultaneously effected.

It is when they are met with in the substance of the tongue or in that of a voluntary muscle that gummata are most likely to be mistaken for new growths. In these situations they are not infrequently exceedingly slow in their processes of change, and very firm in structure. The tendency to break down or suppurate varies very much in different parts. When suppuration occurs, it is to be understood that it takes place around, rather than actually in, the tissue involved. The latter may, however, break down and disintegrate, or may be detached by exfoliation. Indeed, when an abscess occurs in connection with a gumma, it is almost always accompanied by a slough or sequestrum. When a gumma has ulcerated the diagnosis from new-growth of a malignant character may sometimes still remain very difficult, and especially is this the case in gummatous ulcers of the tongue. The undermined edges, the sloughy base, and the entire absence of anything like warty outgrowth, will, however, generally suffice as grounds for a decision. If they do not, a short course of full doses of the iodide of potassium may be tried. As a rule, when a gumma undergoes resolution by treatment it disappears entirely, leaving little or no thickening of the part; but occasionally, and especially in connection with the periosteum, some permanent sclerosis results. Even in connection with bones, however, the completeness of the final resolution of very chronic and very firm lumps is often most remarkable.

Although iodide of potassium, as a rule, displays its power most definitely and rapidly in reference to all stages of the gummatous process, there are some cases which yield to mercury even more quickly than to it, and a few in which the latter will succeed when it has failed. Especially is the latter the case in certain indurations of periosteum of bone, which will yield to nothing but the full mercurial influence. In the treatment of ulcers from gummata which have broken down, local remedies are of great importance, and in many instances will alone suffice for cure. Amongst these iodoform is the chief. But not infrequently a free cauterisation with the acid nitrate of mercury will even yet more rapidly produce healthy action. The process of repair under appropriate treatment is usually rapid and complete. The scar left is often more or less peculiar, owing to the large amount of cellular tissue which may have been destroyed. In like manner, when a gumma in one of the viscera undergoes absorption, an internal cicatrix with surface depression is the common result.

Gummata have been recognised in almost all the viscera. They are common in connection with the testis, the liver, and the cerebral meninges. When occurring in the substance of the lung they lead to what is known as syphilitic phthisis, and both here, and in connection with the muscular substance of the heart, they are occasional causes of deaths directly from syphilis. In most of the positions just named, however, their recognition and treatment concern medical rather than surgical practice.

Amongst the peculiar forms of gumma may be mentioned those which develop in connection with the venous and lymphatic systems. In the late stages of tertiary syphilis we not infrequently witness a tendency to induration round the cellular tissue of the veins of the lower extremity, especially if these have been previously in a diseased condition. Lumps of induration, elongated in form, may be met with at more than one place on the same leg, and they may extend and become confluent, producing a large cake-like mass. Some of the most troublesome ulcers we encounter in the leg are the result of periphlebitic gummata. When the lymphatic system is affected we sometimes meet with little shot-like swellings, developed at variable positions in the course of lymphatic trunks. These are often very slow in their development, and remain for long without breaking down. They may occur at almost any stage of syphilis, but are less common in the later ones, and they appear, so far as the writer's experience has gone, to be more influenced by mercury than iodide of potassium.

Histologically, a gumma consists of what is known as granulation tissue, its softness or induration varying with the proportion of its cells. When its fluid constituents are abundant it presents on section a soft gelatinous appearance, from which its name is derived. JONATHAN HUTCHINSON.

GUMS, Affections of the.—HYPERTROPHY OF THE GUMS occurs as a congenital affection, and many cases of it have been recorded. In the *Medico-Chirurgical Transactions*, vol. lvi., is a record of three children of one family, who all presented hypertrophy of the gums, and were also the subjects of *molluscum fibrosum*. All three children were of weak intellect. The writer brought before the Odontological Society of Great Britain, in 1878, two remarkable cases of hypertrophy of the gums, one in a child of five years, and the other in a young man of twenty-six. In the child, the hypertrophy was general, involving the whole of the gums of both jaws; but, in the young man, it was partial, being confined to the gum and alveolus of the right side of the lower jaw, from the right wisdom tooth to the left canine.

A cure was effected in both cases by removing the affected alveolus with the contained teeth, by means of powerful cutting forceps, and nothing less severe is effectual, since it has been shown by Mr. Charles Tomes that, in these cases, the disease dips into the socket of the teeth, and that, therefore, mere paring away of the redundant gum does not effect a cure.

A *nævoid* condition of the gum is occasionally met with as a congenital affection, and co-existent with extensive port-wine staining of the face. In an otherwise healthy young woman, the nævoid growth appeared to take on greater activity with each pregnancy, and the writer removed the vascular outgrowth on two or three occasions, applying the actual cautery freely for the arrest of hæmorrhage.

A vascular, non-congenital tumour of the gum may originate from irritation of the teeth, especially in the region of the incisors. When small, these growths may be treated with caustics, but, if large, and causing hæmorrhage, they should be removed, and the surface from which they grew be touched with the actual cautery.

POLYPUS OF THE GUM, or simple hypertrophy due to irritation, is not uncommon in the neighbourhood of decayed teeth, or when an accumulation of tartar has been allowed to take place.

The affection, when of considerable size, may resemble epulis, but differs from it in being unconnected with the periosteum, and hence requires much milder treatment. The removal of the tartar or the decayed teeth and the use of an astringent wash are sufficient treatment in most cases, and if the growth is large it is generally pedunculated, and therefore readily snipped off with scissors, or, if sessile, may be cut off and cauterised with Paquelin's cautery.

GINGIVITIS, or inflammation of the gums, is a common affection in infants who are cutting their teeth. The mouth is hot and tender, there being a constant dribbling of saliva, and the child's health is interfered with by the loss of rest and by diarrhœa, and possible convulsions caused by the irritation of the system.

Free lancing of the gums is the only trustworthy remedy, and should be had immediate recourse to in all cases of severity, although in slight cases rubbing the gums with the *syrupus croci*, or one of the numerous but dangerously narcotic 'soothing syrups,' may be sufficient.

A *spongy condition* of the gums, often called scurvy, but which differs entirely from the gum of true scurvy, is common in persons who neglect the cleanliness of their teeth, or are in feeble health. According to Salter, the disease consists essentially in vascular dilatation of the papillary and other capillaries, with a general thickening of the gum itself. The treatment consists in improving the general health, and in using the tooth-brush vigorously with some astringent mouth-wash.

The spongy gum due to the administration of mercury differs from the preceding in presenting a well-defined red line along the margin of the gum before the sponginess comes on, combined with fetor of breath and a metallic taste. The blue line of plumbism is due to a formation of sulphide of lead, and the green line of copper-poisoning to the oxidation of copper in the superficial tissues of the gum.

In *true scurvy*, due to deprivation of vegetable diet, the gums are swollen and livid from submucous extravasations of blood, and they bleed on the slightest touch. In advanced cases the gums become black and sloughy, protruding between the lips, and are horribly offensive. Such cases are seldom seen except in seamen who have been improperly fed, and deprived of lime-juice during a long voyage; but mild cases of scurvy, characterised by subcutaneous ecchymoses in other parts of the body, may be met with, and, like the more severe ones, yield promptly to the administration of fresh fruit and vegetables.

Bleeding from gums apparently healthy is a common symptom of the hæmorrhagic diathesis, and may be best checked by pressure, and by the administration of hæmostatics in the form of iron and the mineral acids.

EPULIS is a term often used to include any form of tumour involving the gum, but may be conveniently restricted to the fibrous form, which alone is strictly connected with the alveolus and gum. It is a slowly-growing tumour, arising most commonly between two teeth which may or may not be decayed. By pressure it tends to separate the teeth if they are healthy, or may completely cover in the stumps of decayed teeth. An epulis is closely connected with the periosteum of the alveolus. Mere cutting away of the growth is insufficient for its eradication, and nothing less than cutting away the portion of alveolus from which it springs, or inducing its exfoliation by the application of the actual cautery, can be relied on. In order to do this, it is generally necessary to sacrifice the tooth on each side of the growth, and occasionally in removing the tooth the whole growth comes away, being attached to the peri-odontal membrane in these cases, instead of to the alveolar periosteum. An epulis on section is found to consist of dense fibrous tissue, closely resembling the normal gum, and frequently contains masses of bone, which may or may not be directly continuous with the alveolus.

MYELOID TUMOURS are not uncommon about the alveoli (hence 'myeloid epulis'), but are only the superficial portions of deeper growths. The remarkable feature about these growths is the dark colour which is often to be seen on the surface of the gum-tumour, previous to or, more frequently, after removal. A very thorough and complete removal of these growths is necessary to ensure a cure, and hence they are more properly classed among tumours of the jaw, which they commonly involve.

PAPILLOMA occasionally affects the gums, and requires free removal. Salter describes a case of the kind which occurred in Sir W. Fergusson's practice, where recurrence after removal had frequently taken place.

ULCERATION OF THE GUM occurs in children as the result of stomatitis, but in the adult may be due to struma, syphilis, or epithelioma. Salter narrates a case of strumous ulceration affecting the gums and palate in a youth of nineteen, of highly strumous diathesis, and thinks the disease may be more common than is supposed. Syphilitic ulceration may affect the gums, as well as other portions of the buccal mucous membrane, and occurs, as a rule, below middle age.

EPITHELIOMA affects the gum in patients over forty, and is often apparently connected with irritation caused by ill-fitting tooth-plates. Any ulceration in the mouth of an elderly patient, which does not heal readily, should arouse a suspicion of epithelioma, and this is to be insisted upon the more strongly, because in the early stage, cases of this description are generally seen by dentists, who do not always appreciate the full gravity of the case, and the necessity for prompt interference.

When fully developed, the ulceration is ragged and irregular, and tends to spread from the gum to the cheek externally, or to the side of the tongue internally. The teeth in the neighbourhood are loosened, and possibly the submaxillary lymphatic glands may be enlarged, as they always are in the later stages of the disease.

Having treated several cases of epithelioma of the gum, the writer is convinced that nothing but very free removal offers the patient a chance of permanent relief. It is impossible to say how deeply in the jaw the epitheliomatous growth may have penetrated, and, therefore, it is better not to be content with simply cutting away the alveolus with bone-forceps, but to remove a piece of the whole thickness of the jaw well beyond the disease. It is true that this leads to a permanent deformity, which one would gladly avoid; but to do less is almost to court failure, with possible infiltration of the lymphatics and a rapid termination. CHRISTOPHER HEATH.

GUNSHOT WOUNDS.—All injuries caused by projectiles impelled by the explosion of gunpowder have been included under the term 'gunshot.' They differ from the accidents of civil life in the peculiarities of the conditions attending them, the producing causes, the dangers and complications liable to arise in their course, and the difficulties which surround their treatment, often under very unfavourable conditions. Gunshot wounds may be most trivial in degree, or productive of injuries of terrible severity; yet in all their phases, whether simple or complicated, the principles which mark the advance of modern surgical science are as applicable to gunshot wounds as to the injuries met with in civil practice.

It is not easy to define precisely a gunshot wound, because under this title is included so great a variety of injuries produced by different kinds of firearms. We have bullet wounds occasioned by conical and round bullets, pistol shot, and small shot, as well as the extensive injuries which result from shell explosions. The latter, when produced by minute fragments, possess some of the characters of bullet wounds. In some cases they may be very severe, and resemble somewhat the extensive injuries caused by machinery, and met with in civil practice. In other instances a limb may be carried away, smashed up, or large portions of the body shattered out of all recognition by a shell exploding near at hand.

BULLET-WOUNDS.—A wound by a rifle bullet may be defined in very general terms as a contused and lacerated wound, accompanied by loss of substance, and, in respect of its great length or depth compared with the size of the external orifice, it possesses peculiarities usually associated with punctured wounds. The gravity and relative importance of gunshot injuries are in relation to the region of the body struck, the structures implicated, the size, shape, density, and velocity of the projectile.

A bullet striking tangentially may inflict a mere contusion which, in the case of large projectiles, may be of the severest kind. It may groove the skin and subcutaneous tissue for a greater or less distance, or pass immediately beneath, causing the so-called seton wound. In other cases it may traverse the whole thickness of a limb, or the body itself, from side to side. It may go longitudinally, or in any other direction. In one case the soft parts only shall be injured; in others, the bone may be extensively comminuted and fissured. Vessels and nerves may be divided, viscera and great cavities wounded, and joints penetrated. In any of these cases, the ball or portions of clothing may remain embedded, entailing the evil consequences due to the presence of a foreign body. Again, the bullet shall emerge, often strangely altered in shape, or even divided into one or more portions. The track of the missile may be quite short, or extend along one-half or more of the body, bearing evidence of contusion throughout, and often perhaps of explosive violence.

In discussing the character and consequences of bullet injuries, reference will have to be chiefly made to those produced by conical projectiles. The old round ball is no longer in use. It was larger and softer than the modern bullet; but the chief differences in the wound it inflicted were due to its much lower velocity, the readiness with which it was deflected from the straight course, its very eccentric conduct in traversing the tissues, important parts lying apparently directly in the way being passed by uninjured or at most contused, and the frequency with which the bullet lodged. The conical rifle ball has an enormous initial velocity and great penetrating power. Its course through the body is more direct. It is less liable to deflection, and the damage it occasions is greater.

The modern bullet exhibits several varieties in shape and size. Usually it is a cylinder of lead with a rounded extremity, or in some cases ovoid in form, like the projectile of the needle-gun. One result of the rapid flight of the projectile is that in half of the cases in which it hits the body it is altered in shape. And when it strikes a bone, it is flattened and twisted in all manner of ways, or even divided into two or more portions.

When a bone is struck by a bullet at full speed, perpendicularly to the surface, it is apt to punch a round opening in it with sharp, well-defined margins. A loss of substance, equal to the area of the ball, will be seen at the point of entrance; the exit opening will be larger, more irregular, and the bone-margins more or less everted. Fissures almost universally co-exist. This form of fracture is best seen in the spongy extremities of the long bones and in the flat bones. It is rare in the compact tissue of the shaft. When the velocity is diminished, the bone may be the subject of partial fracture, an indent, a fissure, or a mere contusion.

In the soft parts the entrance wound is sharply defined, and smaller in area than the bullet, while its edges are contused, inverted, and depressed. The exit wound is irregular, with everted margins resembling an ordinary lacerated wound. A diminished velocity, as a rule, causes the wounds to be less regular and larger. The subsequent course of the bullet deviates greatly from the direct path. It is, perhaps, capable of penetrating but a short distance; it may even fall out of the wound again, or finally it may inflict only a contusion without breach of surface.

Grooving, furrowing, or gutter wounds are produced when the bullet strikes obliquely, so that it travels for some distance parallel to the surface. They are most frequently seen on the head, face, and extremities. They vary in length and depth from a mere scratch to a deep channel, with irregular, contused, and lacerated margins. Sharp angular fragments of shell often produce them, and they are very painful and tedious in healing.

Seton wounds are similar in type to the last in being superficial, but the projectile travels for a certain distance close beneath the surface of the body before it emerges. They may be an inch or two or several inches in length; the manner of production is by a bullet striking tangentially at full speed. They may be seen on all parts of the body except the head. The track of the ball is easily traced by the bluish discolouration on the surface. As the bullet does not meet with any hard body it is rarely much altered in shape, and the distinctive features of the entrance and exit wounds are usually well marked.

Traversing wounds constitute nearly half of all the injuries inflicted by gunshot. Sixty-five per cent. occur in the extremities, twelve per cent. in the head, seven per cent. in the chest, six per cent. in the abdomen, five per cent. in the back, and three per cent. in the neck. The greater number of gunshot wounds traverse the tissues, inflicting a variable degree of injury according to the nature of the resistance which the traversing projectile meets. Bone offers the greatest obstacle and generally suffers the most extensive injury. Skin, tendons, and fascia come next; they also are capable of altering the shape of the ball. Small leaden projectiles flatten on tendons as they generally do on bone. In the muscles there may be much loss of substance, especially if they be in a state of tension when struck. The viscera offer least resistance.

It is rare, except after a ricochet shot, to have more than one wound of entrance produced by a single bullet, but it not infrequently happens that there is more than one exit wound; more than two, however, are rarely seen. The high velocity of the ball often causes it, as has already been stated, to split into two or more portions when striking a bone, and the over-heating or partial melting of the bullet from the same cause renders this still more likely to ensue. A gunshot track is by no means a perfect cylinder, the opening in the skin is slightly smaller in area thān that of the bullet, but in the aponeurosis there is often a mere slit, so that when suppuration occurs, it will be confined beneath the fascia. This circumstance no doubt led to the formerly much-employed practice of *debridement* or free incision of gunshot wounds. Balls make the largest channel through muscles.

The direction of the wound when a rifle ball strikes at full speed at right angles to the surface may be straight, but often it is very devious. A contracting muscle, a tense fascia, a tendon, and of course, bone, generally deflect a bullet. Any change of posture after the receipt of injury alters the direction of the track, which might become straight again could the individual replace the body in the exact attitude assumed at the moment of injury. The length varies;

it may be quite short; on the other hand, it may extend half the length of the body, or more. The soldier generally shoots in the recumbent posture, and when struck as he lies upon his face, the bullet may travel the entire length of the back, or from the wrist up to the shoulder, or entering the neck pass through the chest and abdomen, from before backwards or diagonally.

Gunshot injury may be complicated by wounds of the blood-vessels, nerves, viscera, or by the penetration of a great cavity or joint. These wounds are always severe and their prognosis serious; they occur much more frequently since the introduction of arms of precision.

The relative frequency with which wounds are met in the different regions of the body varies with the circumstances of every war. It is calculated that of 100 wounds, by gunshot, 13 will be found in the head, 19 in the trunk, 28 in the upper extremity, and 38 in the lower. There has been an increase during later campaigns in the number of head wounds, which may be accounted for by the method of modern fighting. During sieges and in fighting from trenches, the proportion of head injury varies from 25 to 30 per cent.. Here the frequency of injury in the upper extremity remains the same, but the number of wounds in the trunk and lower extremities diminishes in proportion.

Wounds inflicted by pistol balls, either of the conical form, or, less frequently, the round shape, are often met with in civil practice. Generally the injury is self-inflicted; sometimes it is accidental. In the former case the weapon is always fired at very short range or point blank. The surface is often discoloured or burnt. Particles of unconsumed powder are embedded in the skin or neighbourhood of the wound. These injuries resemble, on a smaller scale, the wounds by rifle bullet. The size of the ball is smaller, it is impelled with less force, and the damage it inflicts in general is not so severe.

Injury by Small Shot.—Wounds produced by the discharge of small shot from fowling-pieces is one of the most frequent forms of gunshot injury met with in civil practice. The amount of damage they inflict varies according to the distance from which the piece is discharged. A charge of shot, delivered point blank, inflicts most extensive injury, entering the body like a solid mass of metal, and then spreading in all directions. Here the entrance wound will be very large, its margins crenated. In a few instances the charge, or the bulk of it, may traverse the part wounded. The exit wound in that case will be very irregular and lacerated, and has a sieve-like appearance at the margins from isolated shot-pellets passing out separately.

Injury by Explosive Shells.—The explosive conical shell, used in modern artillery warfare, produces injuries of very varying degree. The injury is caused by the impact of the fragments into which the iron case of the shell bursts, and the leaden sheath which surrounds it. The damage depends on the number and the size of the fragments striking the individual, and the proximity of the explosion. The pieces vary in weight from half an ounce to half a pound or more, and are of all possible varieties of shape. They inflict lacerated wounds, often very irregular; tear away large portions of tissue or even an entire limb, smash the bone, or possibly reduce the entire body into a shapeless mass.

The proportion of men wounded by artillery fire, to those injured by rifle bullets, varies much in different battles. In the war in Bohemia, 90 per cent. of the wounds were caused by rifle bullets, only 3 per cent. by fragments of shell. At Plevna the wounds inflicted were all bullet wounds. In the Franco-German war, 20 per cent. of the wounded on the French side were injured by artillery, and 70 per cent. by rifle shot, while among the Germans only 5 per cent. were injured by artillery, but 94 per cent. received rifle wounds, so that the proportion varies much. In sieges the number of shell injuries always proves excessive.

Symptoms of Gunshot Injury.—There is very often a singular absence of severe pain at the moment of the infliction of a wound. This is true even when important nerves are severed. The greater the excitement, the less is the pain experienced. In a considerable number of instances, a man will be unaware that he is even hit until he becomes faint from loss of blood. The majority experience a sensation as if struck a severe blow by a stick, others a species of electric shock. In a few a severe burning pain is felt, rarely bad enough to occasion syncope. The pain is occasionally referred to parts other than the one struck, as in the testicle from a wound in the upper part of the thigh, or in the heel from injury to the buttock. Afterwards the amount of suffering will depend much on the circumstances in which the wounded man is placed. The beaten soldier will feel it more than the victor, or than one speedily and well cared for.

It is notorious how different various nations are in respect of endurance of pain. Pirogoff observed that Jews, Mussulmans, and Slavs bore pain well. Italians and Poles are very sensitive. The writer observed a total indifference to suffering among the Turks. He has often witnessed soldiers dying of mortal injury quite cheerful and unrepining, and he remembers well a man whose arm had just been amputated, insisting on seeing the next operation performed, to know how it could be done while the patient was unconscious of pain, and calmly smoking a cigarette the while.

As a rule, primary bleeding is an unimportant symptom in cases of gunshot injury which come under treatment, wounds of the face perhaps excepted. But hæmorrhage is nevertheless the cause of death in the majority of those who die on the field itself. Those wounded in the abdomen usually present a blanched appearance, and the same thing holds good of wounds of the thorax. There is often much blood on the clothing and ground, primary hæmorrhage from large venous trunks being as rapidly fatal as from important arteries. It has been recommended that every soldier should be provided with a tourniquet, but, as no instance has been recorded of life being saved in this way, the instrument would be quite useless.

Ligature of a large vessel for primary hæmorrhage is an almost unknown operation. Lidell records, as his personal observation after several severe battles, that he had not met with a single case of primary hæmorrhage which required a surgical operation such as the application of a ligature, and a similar statement has been made by other experienced military surgeons. It has often, of course, been performed for secondary bleeding. The results, which it is not needful now to particularise, have not been unsatisfactory.

Shock is a prominent feature of many gunshot injuries. It does not always stand in direct relation with the severity of the wound; it may be severe even after slight injuries. Local shock—the ‘wound stupor’ of Pirogoff—is confined to the injured part, which after a period of severe pain becomes cold, blue, numb, and difficult to move. The condition may pass off, or motor and sensory paresis, with general shock, may be developed.

General shock is observed in the more severe forms of gunshot injury, as, for instance, where a limb has been extensively damaged, or the viscera wounded; symptoms of severe shock often following injury by shell-explosions. The larger the area of the superficial injury and the nearer it is to the centre of the body, the more intense will be the shock. In some less severe cases of injury it can only be accounted for by psychical causes. It is always greater in nervous persons, and in injury of certain regions, as the abdomen, genital organs, the fingers and toes. The normal bearing of a wounded soldier, however, is usually one of much fortitude and endurance of suffering. In general shock the patient becomes pale and faint; he trembles, the skin is cold and sweating, the pulse small and irregular, the respiration shallow and frequent. In other cases there is extreme restlessness, anxiety, and a feeling of impending death. After an interval reaction sets in, the face becomes flushed and restlessness increases, accompanied perhaps by delirium, exaltation of the senses, small and frequent pulse and rapid breathing. The temperature generally falls two or three degrees below the normal standard. Cases where there has been great loss of blood generally suffer severely from shock; on the other hand it is sometimes entirely absent, even after very severe injury. The usual treatment should be employed, warmth applied, stimulants administered, all bleeding stopped, and the patient made to feel that he is being cared for.

Instantaneous rigor mortis is a condition occasionally observed after sudden death from gunshot wound. Instances of this almost inexplicable phenomenon are observed on all large battlefields. The bodies of the dead are to be seen with the action in which they were engaged during the last moments of life apparently continued; the position is probably one quite contrary to the action of gravity. The last muscular effort is stereotyped as it were. This condition may remain persistent for days, as the writer has personally witnessed. The expression of countenance at the moment of death is also preserved, and the body has the appearance of continuing the effort to accomplish some object desired at the moment of death. Dr. Dossbach mentions the case of six Frenchmen killed by a shell as they were taking breakfast; one appeared to be laughing, the man next to him was holding a tin cup to his lips between his thumb and forefinger. Dr. Brinton mentions the case of a cavalry soldier who was instantaneously killed while in the act of mounting his picketed horse; he was found with his foot in his stirrup, his left hand on the bridle and horse's mane, and when the body afterwards fell to the ground it remained quite rigid in the attitude described. This condition occurs most frequently after injuries to the brain and spinal cord. Dubois-Reymond has called it cataleptic rigor mortis. Any explanation seems very difficult.

PROGRESS OF GUNSHOT WOUNDS OF THE SOFT PARTS.—Formerly suppuration was the all but inevitable result of gunshot wounds. An effort is now made to procure healing by scabbing, and if the circumstances be favourable, these wounds heal oftener without suppuration than is commonly imagined. The smaller the bullet the more likely is union without suppuration to follow. The writer has seen pistol wounds heal by first intention, and not infrequently wounds produced by a rifle bullet, more especially that of exit.

It is the absence of suitable treatment in the first instance, the too frequent interference with the wound, the introduction of septic matter from without, and the insanitary conditions in which the wounded are placed, which render healing without suppuration comparatively rare. Langenbeck in the war of 1850, Stromeyer and Beck in 1864, the English and French surgeons in the Crimea, had never seen cases of recovery without suppuration, and, without doubt, suppuration is the rule in such cases. Baudens and Jobert saw wounds unite without suppuration which had been inflicted during the street fighting in Paris. Pirogoff has noted cases of union occurring primarily after wounds by small copper bullets; and during the Franco-German and Russo-Turkish wars many instances are reported of this manner of healing. A scab is formed by the blood and serum drying up. Absorption of the poured-out fluids in the interior of the wound occurs, and perfect recovery follows. In some cases of apparent primary union suppuration sets in at a later period, generally spreading from the entrance wound, whose bruised margins are prone to suppurate; or suppuration begins afresh in the interior of the wound a considerable time after cicatrisation. This is usually caused by the irritation of a foreign body, such as pieces of clothing and the bullet, which, even after an interval of years of quiescence, may excite inflammation and suppuration afresh. When suppuration takes place, it is often tardy in its appearance. For a week, or even ten days, there may be only a bloody serous discharge, attended by some inflammatory swelling in the immediate neighbourhood of the wound. The degree of fever is variable. There is often little or none, or severe traumatic fever may set in, merging, in too many cases, into the septic form. When the wound is treated antiseptically, both local and general symptoms are minimised.

The secondary stage extends from the occurrence of suppuration to the time when all particles of dead tissue are cast off and a granulating surface takes the place of a contused one. The fever abates, the swelling diminishes, and the ordinary changes of repair follow. The duration of this stage varies with the extent of the injury, the method of treatment, the constitution of the individual, and the circumstances in which he is placed. Cicatrisation may occur in the centre of the canal, or one or other external wound may close, the wound of exit being the first to heal. The period required for complete healing varies very much. From three to six weeks is a common estimate, but in complicated cases from three to six months may elapse before final cicatrisation takes place. Wounds caused by splinters of shell heal more readily than those inflicted by rifle bullets. The cicatrix may be adherent. It is often painful and neuralgic, as well as very sensitive to changes of weather. When the wound is deep and extended, the venous circulation may be interfered with, and chronic œdema ensue. The writer has seen this invade an entire limb; the extremities, however, are the parts usually most affected.

Diffuse suppuration is a common result of gunshot injury, and very commonly associated with a septic condition. Before the introduction of antiseptic methods this was a frequent source of death. The writer has again and again seen this, both in simple wounds involving the soft parts and those implicating the bone. The pus spreads in the cellular tissue between the muscles, and in the neighbourhood of the bone. It is most common in deep-seated wounds. Septic phlegmon is a very common cause of death after gunshot fracture. It may also occur in wounds of the soft parts. The suppuration in this case becomes widely diffused beneath the fascia. There is often a hard œdema. The skin is red and shining, the wound grey and foul, with a profuse secretion of ill-smelling pus, high fever, albuminous urine, diarrhœa, delirium, and finally a typhoid state. Upon incision the tissues are found dense, with greyish infiltration. Death generally occurs through sepsis or exhaustion. There is no tendency to limitation. United fractures or partially cicatrised wounds break down again.

Septic suppuration, followed by infection, is common in all wars. Its frequency has been much diminished by the introduction of antiseptic methods. Formerly it more than decimated the wounded, and was especially common and fatal after gunshot fractures and operations which involved the bones.

COMPLICATIONS IN THE COURSE OF GUNSHOT WOUNDS.—Secondary hæmorrhage is one of the most common and fatal of the accidental complications following gunshot injuries. The period of separation of the slough in the gunshot track is frequently associated with secondary hæmorrhage. Severe and fatal bleeding, however, may occur at any later period, and, as the writer has observed, even after apparent convalescence has taken place, more especially in wounds of the neck and face. In this case, perhaps, only a small fistula or trifling discharge persists. After ligature of the vessels, and after amputation, secondary hæmorrhage is very frequent. The operation may perhaps have been hastily done. The patient is transported a long distance afterwards, the wound suppurates, the after-dressing is imperfect, the food is bad, and the hygienic conditions probably even worse. The separation of a slough, and imperfect organisation of the clot, are the exciting causes. These are the principal conditions which occasion the distressing frequency of secondary hæmorrhage in time of war. It occurs most commonly in the evening or night, when the patient is feverish and restless. It may follow a prolonged dressing, accompanied by much syringing out of the wound, or a too frequent examination of the wounded part.

Warning bleedings to a limited amount precede the outbreak of the more severe hæmorrhagic attacks in about one-fourth of the cases. In only a small proportion does secondary hæmorrhage occur on a single occasion. It usually recurs twice, thrice, or even several times. Usually it is not difficult to distinguish arterial from venous and capillary bleeding; but when the blood comes oozing from a long, deep track, it may not prove easy to determine its source.

Secondary bleeding occurs early on the fourth or fifth day; it ensues with, perhaps, equal frequency till the eighth or tenth, reaching its maximum on the tenth and eleventh days, when the greatest number of hæmorrhages occurs. It then remains nearly stationary till the fifteenth or sixteenth day, when it begins to diminish in frequency, up till, say, the thirtieth day. After amputation, bleeding most frequently ensues at the period when the ligatures separate. The mortality after secondary hæmorrhage has been variously estimated at from 60 to 80 per cent. of the cases. It differs in the different regions of the body, but is greater in cases of gunshot fracture than where the soft parts only are concerned.

The *treatment*, in the first instance, is guided by simple principles. If the bleeding is severe, or cannot be arrested by pressure and other means, an effort must be made to stop the bleeding at the injured point. The ends of the vessels must be laid bare by dissection, and a double ligature applied; only where the attempt to secure the bleeding points in the wound fails may a ligature be applied at a distance. The mortality after ligatures in continuity is one-third greater than that following ligation in the wound. The results of treatment, as the high rate of mortality shows, are not favourable. In the wound itself there are always difficulties to be overcome in reaching the seat of hæmorrhage—difficulties which may prove insuperable. In regard to tying the artery in its continuity, the effect on the hæmorrhage is often very trifling, or only temporary; and, even if it be arrested, the bleeding often recurs at the time the ligature separates. The fact that the occurrence of secondary hæmorrhage so often depends on faulty hygienic conditions, overcrowding, and a foul condition of the wound, serves to explain the non-success of local measures for its arrest.

TETANUS is a somewhat rare complication of gunshot wounds, although it is commonly supposed to be frequent. It occurs oftenest in those who have been exposed to hardship, extremes of heat and cold, presence of bone-splinters, unskilful treatment of the wound, and in cases of injury to nerves. The writer only saw one instance in upwards of one thousand wounded at Sedan, and in that one the man had been exposed for three days on the battle-field before he was picked up. During the Revolution of 1830 three hundred and ninety wounded persons were carried direct from the streets of Paris into the Hotel Dieu. Only one of these suffered afterwards from tetanus. In the American war the frequency was only 0·2 per cent., or two in one thousand. It occurs with preponderating frequency, or in more than half the cases, after injury of the lower extremities. Tetanus is especially rare after wounds of the chest; the later the period of its occurrence after the injury the more favourable is the prognosis. Recovery occasionally takes place in the slighter or more chronic forms. It is exceedingly rare in the well-developed acute form, when death is apt to take place within three days. Out of 203 acute cases observed during the American war only 2 recovered. The total number of all kinds of cases was 337, of which 316 terminated fatally. *See* TETANUS.

In a few instances the symptoms abate on the removal of the projectile or foreign body. Amputation was successful in one-third of the cases in which it was resorted to. The treatment otherwise is purely empirical. All forms of narcotics have been tried in succession, with equally little effect upon the progress of the malady.

GANGRENE.—Acute gangrene may take place as the result of the wound of an important blood-vessel. Division of the sciatic nerve seems sometimes to produce it, or the severe smash occasioned by a shell-explosion.

Dry gangrene is excessively rare.

In the vast majority of the cases—as many as 90 per cent.—gangrene of some kind is the result of injury to the extremities. In two-thirds of these cases the lower extremities, and in one-third the upper extremities, will be the part involved. The general mortality is about 50 per cent. Traumatic delirium soon occurs. There are great restlessness, want of sleep, and anxiety. Symptoms of septic infection frequently supervene. In a certain number of cases amputation may be resorted to.

HOSPITAL GANGRENE is an epidemic contagious disease occurring in over-filled, badly ventilated, foul hospitals. It is especially prone to attack gunshot wounds. The first great epidemics described occurred during the Peninsular campaign in 1810–13. The disease, however, seems to have been known to Paré. In the latter six months of 1813 Guthrie treated 1,614 cases, of which 512 were fatal. The disease at the same time overran all the French hospitals. Out of 1,900 wounded in the Hôpital St. Louis in Paris, 500 perished of hospital gangrene. It was very severe after the battle of Waterloo in the hospitals of Brussels and Antwerp. It was common at Scutari and Malta during the Crimean campaign, and very bad amongst the French troops, especially in their ill-equipped transport ships. At Lucknow, in 1857, nearly all the wounded were attacked. It was common in the American war in 1864, when 2,642 instances were recorded. Scarcely any cases were observed during the Franco-German war, except in some of the hospitals of the reserve and in the besieged fortresses of Metz and Strasburg. A good many, however, occurred in Orleans.

The presence of epidemic disease such as typhus, cholera, scarlet fever, and diphtheria, seems to promote the occurrence of hospital gangrene, which Pitha, indeed, terms 'wound cholera.' The virus is very contagious; it may be carried from one wound to another by sponges, instruments, even the surgeon's fingers or clothing. It may appear even on a recently blistered surface. Wounds of fascia, tendons, and soft parts generally seem more prone to it than gunshot fractures. *See* HOSPITAL GANGRENE.

ERYSIPELAS is an uncommon occurrence after gunshot injury. American records place it at 4·0 per 1,000; it occurs after exposure to cold, and from great changes in temperature. The washing out of the wards is often followed by an outbreak of erysipelas. It occurs more especially on the head, face, and neck, or in about six cases in every thousand. On the trunk the proportion is 1·2, in the upper extremities it is 5·2, and in the lower 4·7 out of every 1,000 cases of wound. It may take place at any stage of the wound. It is very contagious. The duration averages ten days. It is often associated with or followed by pyæmia.

Generally the disease broke out in ill-ventilated, crowded hospitals, or was communicated by contagion.

Bromine vapour has been found a useful prophylactic, and without doubt the general introduction of disinfectants and antiseptic treatment will practically banish it. Sporadic cases, however, may ensue, even under what appear the best arrangements. These must at once be isolated, and otherwise the same treatment which is adopted in civil practice should be carried out. Antiseptic treatment to a large extent prevents erysipelas. Alcoholic stimulants, quinine, salicylate of soda, benzoate of soda, and narcotics are the remedies indicated, together with local subcutaneous injections of a third per cent. carbolic solution immediately around the diseased area, which prove especially useful at the beginning of the disease. *See* ERYSIPELAS.

GENERAL TREATMENT OF GUNSHOT INJURIES.—The means for removing the wounded from a battlefield to the dressing-stations and field-hospitals is treated of under AMBULANCE. It is only necessary to say here that the simplest form of stretcher

—one that can afterwards be used as a bed—is the best. The recovery of many will depend on how this part of the work is carried out.

Cases of fracture bear transport badly, and the chances of recovery after gunshot fracture of the thigh depend, to a large extent, on the ability of the surgeon to treat the cases as near as possible to the place where the wound has been received.

At the first dressing-stations it is imperative that the best surgical opinion should be forthcoming, for on the early diagnosis of the nature of the injury will depend the success of the treatment. Here, too, must be decided what treatment—conservative measures with antiseptic occlusion of the wound, amputation, or resection—will be best. The surgeon should not waste time over hopeless cases. None but operations of emergency should be performed on the field. Bleeding must be arrested, fractured limbs supported, limbs completely smashed amputated, the wounded refreshed and comforted, and then despatched as quickly as is practicable to the field-hospitals. In them complete examinations can be made, thorough antiseptic precautions taken, and the needful operations performed. With regard to the much discussed question of first dressings, the writer is convinced that the first dressing should, if possible, be a final dressing, and that this should be the aim of all military surgeons. He has but a limited belief in the practical efficiency of the packet of first dressings as carried by the soldier himself.

The frequent necessity for the extraction of a lodged bullet, a fragment of shell, or portion of clothing is peculiar to gunshot injury. Popular belief ascribes a deadly influence to the presence of a bullet in the body, and the wounded man urgently begs for its removal, the surgeon too often making an extensive and damaging search for it. A great variety of ingenious bullet-extractors and bullet-searchers have been invented. We have plain probes, articulated probes, probes tipped with porcelain, electrical indicators, instruments gimlet and spoon-shaped. A strong slender bullet-forceps, like Luer's, or the American forceps with rat teeth at the extremity, is the best. It is narrow enough to enter an ordinary gunshot track; when closed it acts as a sound, and if it seize the ball, is not likely to slip. It is quite certain, however, that the former indiscriminate extraction of bullets was often attended with evil consequences, and that vastly more injury was inflicted by ill-judged efforts to remove the ball than its mere presence was likely to induce. If the ball, however, prove accessible, and its removal easy, it may be better to extract it; but long-continued search after a deeply placed ball, or extensive incisions for its release, are to be deprecated. The wound should be treated irrespectively of its presence. It may become encapsuled, or even be removed at a later period.

In cases where the bullet requires to be removed, as where it presses upon an important vessel or nerve, or excites irritation by its presence, the operation should be conducted with extreme caution and the avoidance of all needless suffering. The part should be placed, if possible, in the same position as at the time of the receipt of injury. The gunshot track is thus straightened and shortened. Care must be taken not to mistake a bony prominence for a bullet. Stromeyer mentions a case in which the head of the fibula was thus cut down upon. The writer has known more than one instance in which an attempt was made to extract the transverse process of a vertebra, fatal hæmorrhage resulting.

The treatment of shock after extensive injury first demands attention, especially when produced by shell-explosions. If very severe it may even terminate fatally. Brandy, wine, ammonia, injections of ether, heat to the surface, and sinapisms, as well as stimulating injections per rectum, may be resorted to. In cases of slight shock it is unnecessary to interfere, but excessive reaction must always be guarded against.

The dressing of a gunshot wound must necessarily be of a simple character. In those cases where it is possible, an antiseptic pad, composed of cotton wool impregnated with iodoform or corrosive sublimate, should be resorted to as soon as possible after the receipt of injury, and fastened with a bandage—not, however, too tightly applied. The method of antiseptic occlusion seems to promise the most favourable results, especially in cases of gunshot fractures and injuries involving joints. This is not practicable when the wound is very large, irregular, and with contused margins, or when a considerable interval has taken place after the receipt of injury. Provision should then be made for the freest possible escape of the discharges. Drainage-tubes may be inserted, counter-openings made, and antiseptic irrigation, with frequent change of the dressing, resorted to. The strictest cleanliness must always be enforced, and all used dressings be burnt at once.

The general treatment consists in absolute rest of body and mind. A generous diet should be exhibited, but of a plain and simple description. The bowels ought to be kept regular with gentle purgatives. Anodynes are well borne, and should be given in sufficiently large doses to allay pain and excitement. In young, plethoric subjects, leeching is sometimes indicated, but general blood-letting is never likely to be required. If blood-poisoning threaten, quinine and opium are the most trustworthy remedies. Severe diarrhœa is a very common complication of gunshot injury, and for this, iron and opium are the drugs chiefly indicated.

Special Forms of Gunshot Injury.—Gunshot injuries of *bone* may be classified as contusions, simple fractures, partial perforating, penetrating, and complete fractures. Every form of projectile used in war may cause these various injuries. The nature, extent, and severity of the lesion will depend on the size, form, and velocity of the missile. The discussion as to the comparative effects of the round and conoidal bullets is no longer of practical value since the general adoption of arms of precision. To the cylindriform bullet all now agree in ascribing a greater destructive power. The frequency of gunshot fractures varies much in different campaigns. On the average they occur in about one-fifth of the total number of gunshot wounds.

Gunshot fracture of bone presents special features according to the character of the portion injured, the size and velocity of the projectile. Extensive damage to the bone is associated with comparatively trifling injury to the soft parts—a feature common to all kinds of gunshot fracture, and the converse of what obtains in fractures met with in civil practice. A bullet striking at right angles at full speed makes a canal in the bone, of the same size as the ball itself; the wound of entrance being a clearly-defined, circular opening in the cortical tissue, from which fissures extend upwards and downwards, the exit wound being larger, more irregular, more extensively comminuted and fissured than that of entrance. When the ball strikes obliquely, the bone will be comminuted. If it strikes tangentially, a piece of bone may be carried away, thus producing partial fracture, which may or may not be afterwards rendered complete by the weight of the body or the application of some indirect force.

The simplest form of injury is that in which the bone is contused. In some cases the surface may be depressed, the injury taking place in conjunction with wounds of the soft parts. There will be extravasation of blood beneath the periosteum and in the medulla. The injury most frequently occurs in the exposed bones, especially the lower jaw, the tibia, and the skull. The diagnosis is difficult, as the slighter forms of injury are mostly overlooked at the time. They are generally only recognised by the after-consequences. Their presence may be inferred when the wound is close to a bone, when the ball is found to be altered in shape during its passage, or by a sudden invasion of bone-inflammation or osteitis.

The symptoms are obscure, but a peculiar boring, burning pain is experienced in the bone, the functions of the limb are interfered with, and a swelling may be felt beneath the periosteum. In slight cases, where the conditions are favourable, desirable results may follow, the extravasation is absorbed, and some local formation of new bone may take place. In unfavourable cases, suppurative periostitis commonly occurs, and necrosis. The sequestrum may separate in the usual way, or osteo-myelitis and septic poisoning may take place. The injured part must, in any case, be kept at rest, and symptoms dealt with as they arise.

The bullet may merely groove or furrow the bone, either superficially or deeply, or drive the cortical portion into the medulla. Portions of the bullet are often found embedded, or the ball may be altered in shape or lodge at the end of the furrow. Fissures will probably be always found. This kind of injury generally takes place at the junction of the epiphysis and the shaft. A ball passing between the radius and ulna, or the tibia and fibula, will very often groove both bones. In other cases the ball may pierce the cortical tissue and lodge in a blind canal in the bone. This occurs in the epiphysis and spongy bone. In some of these cases there will be fissures, in others none. The diagnosis is difficult, and the nature of the injury is often only discovered by the subsequent progress of the case. If the ball can be extracted, these fractures will resemble in their progress simple grooving wounds. If not removed, the bullet may become encapsuled or excite inflammatory processes at some subsequent period.

The bullet may pass through the entire thickness of the shaft or extremity of a bone, cutting a channel through it without causing complete solution of continuity. This form of fracture is called *Lochschuss*, or key-hole. It is usually met with in the spongy extremities of the long bones near their junction with the shaft, and is more frequently produced by small bullets. The entrance wound in the bone is the same size as the ball, circular in form, the edges sharp and depressed. The exit wound is large, irregular, the margins everted. Longitudinal fissures are almost always present. At fifteen yards' distance, a chassepôt bullet, fired through the lower epiphysis of the femur, makes a perfectly round wound of entrance, the exit orifice being about ten times as large. The ovoid needle-gun ball, at the same distance, also makes a round entrance-hole in the bone, the exit wound being two or three times larger. The Martini-Henry effects a round entrance, a larger but also rounded exit wound, with limited fissuring. An exact diagnosis, even with the aid of the finger, is sometimes difficult. When recovery ensues, small fragments of bone exfoliate, and the canal becomes filled up, either by callus or fibrous tissue.

The successful treatment of gunshot fracture depends in a great degree on the possibility of antiseptic occlusion, careful immobilisation, and the absence of prolonged transport. Although much longer delayed than in any other kinds of fracture, final consolidation is almost the constant result. The average period of union is one month for the forearm, two months for the arm, three months for the leg, and six for the thigh. A useful limb is generally obtained, but always more or less deformed and shortened. Non-union is exceedingly rare. Death may ensue soon after the injury from shock, hæmorrhage, or injury to some important organ.

After a battle hospitals are filled with cases of fracture. A great many of the subjects die from acute septic poisoning. In some the fatal result may be averted by timely amputation; but when a septic condition is developed, amputation is exceedingly fatal. At a later period amputation may become necessary from the extent of the necrosed fragments, a profuse suppuration exhausting the patient, suppuration taking place in an adjacent joint, or large bed-sores forming by reason of defective nursing.

The practice, formerly much in vogue, of extracting and excising fragments of broken bone is now very properly abandoned. Primary resection of the extremities of the fracture should never be performed; it leads to delayed union, false-joint, or sets up osteomyelitis and necrosis. Pieces apparently loose will often unite quite well, and the attempt to remove them may seriously damage the soft parts. It will, however, in some instances be desirable to remove a fragment of bone pressing upon a nerve or artery, and lying quite loose in the wound or transverse to the axis of the bone.

After the wound has been dressed the fractured limb must be immobilised, the joint above and below the seat of fracture included, and this must be thoroughly done, especially in cases which involve transportation. For these nothing can be better than some modification of the so-called Bavarian splint. Plaster of Paris properly employed, the writer considers, is invaluable. In the treatment of fractures Stromeyer strongly objected to it, and pointed to evil consequences resulting from its use; but these, with reasonable care, may be avoided. His great contemporary, Langenbeck, is very strongly in favour of its employment.

Fracture-apparatus for use in war must be simple, light, strong, and portable. Splints have been supplied of all possible material —tin, zinc, iron, wood, rattan, and wire, but all military surgeons should learn to utilise every available material on the spot. For almost all injuries of the upper extremity Stromeyer's triangular cushion will be found to yield adequate support; in the first instance, at all events, in the lower limb. The straight position, combined with continuous extension, is the best for all kinds of fracture of the thigh. Nathan Smith's or Hodgen's anterior wire-splints, with suspension, are admirable. These splints help to prevent bed-sores—not the least of their many advantages.

In fractures of the leg plaster of Paris splints may be used, a window being left at the wound. Starch, dextrine, white of egg, and water glass are much less desirable media, and are supplanted completely by plaster of Paris. Unfortunately it requires a considerable time to apply plaster splints properly; the weak parts, where windows occur, may be strengthened by slips of thin wood or iron. Undue pressure must be avoided at first, and subsequently the limb must not be allowed to become loose in the splint. Gunshot fractures of the leg are the most frequent variety of fracture of the long bones, amounting to about 31 per cent. of the total number of cases. Those of the humerus come next in frequency, being 28 per cent.; gunshot fractures of the femur amount to 22 per cent., and of the bones of the forearm to 18 per cent.

The views of surgeons as to the methods of treatment and propriety of amputation have greatly differed. At the present time, however, they are decidedly in favour of conservative measures in the majority of cases, especially of fracture of the shaft of the bone. When the fracture is near the ankle or the knee, these joints will probably be involved, and amputation may be the safer proceeding. In choosing a line of treatment, much will depend on the facilities which circumstances afford for satisfactory after-treatment, and the absence of long transport. The limb should be immobilised in a fracture-box or plaster of Paris. Union takes place very slowly; detached portions of bone may be removed, but any more formal resection of the extremities of fractured bones is strongly to be deprecated. When conservative treatment, from any cause, fails, amputation may be practised subsequently. In these, as in other cases, the results will depend on how far antiseptic methods of treatment have proved successful.

GUNSHOT INJURY OF JOINTS. — The number of these wounds varies in different campaigns, but the difference may be accounted for to some extent by the accuracy of the diagnosis. It is estimated that they form from one to two per cent. of the total number of injuries, but they amounted to as much as six per cent. during the Franco-German war. Their frequency is about equal in the upper and lower extremities. The shoulder and knee are the articulations most frequently implicated, the elbow comes next in order, the hip and wrists being the least frequently wounded. The left shoulder is more frequently injured than the right, and the right elbow than the left, which may be explained by the position which a man assumes in firing.

A joint is frequently injured, as before stated, by fissures issuing from an adjacent fracture. In fractures of the upper end of the tibia, fissures almost invariably extend into the knee-joint. Formerly contour-wounds, passing around the joint without opening into it, were described as of frequent occurrence. They certainly are not so now. Wounds apparently of this nature generally implicate the articulation. Injury to the joint-capsule alone is of somewhat common occurrence; this may take place in the knee without injury to the bone, but a gunshot wound implicating the capsule of the hip-joint invariably damages the acetabulum or the head and neck of the femur.

One or both of the joint-surfaces may be grooved or extensively comminuted and fissured by the bullet; the bullet or a portion of clothing may even find admission; the importance of the injury depends upon the extent to which the bone is damaged. It is often extremely difficult to decide if a joint has been opened or not, and to what extent the bones are injured; this will be especially so where the articulation is covered with a great thickness of soft parts. A diagnosis may be arrived at from the position and direction of the wound, and presence or absence of crepitus; an escape of synovia is seldom observed. Sudden swelling immediately following the injury is a very definite symptom, but it is often absent, or, as in the case of the hip-joint, difficult to determine distinctly. Pain is not a prominent symptom. When the bullet has traversed a joint, the patient cannot use it; sometimes, however, he may be able to walk a certain distance, and this has been repeatedly observed even when the head of the femur has been comminuted and the bullet lodged in the bone. In the case of the hip-joint the direction of the wound offers the best indication.

Formerly a gunshot wound implicating a large joint was regarded as certain to occasion suppuration and necessitate amputation. During the Crimean War and in the Italian campaign, the French surgeons amputated the limb for wound of the elbow, and amputation was almost universally considered necessary for penetrating wounds. It is now certain, however, that many gunshot fractures, even of the lower joints, may be recovered from with little or no inflammatory reaction. In many cases a changed position of the limb will alter the wound from a direct to a valvular one, and thus shut off the interior of the joint from external influences, especially in the case of the knee; the great thickness of soft parts covering the hip and shoulder may procure the same result for these joints. But in the wrist and elbow recovery has also been observed without suppuration.

Langenbeck informed the writer that during the war of 1870 and 1871, he had seen a hundred cases of penetrating wound of the knee-joint, in which recovery had ensued without suppuration. Socin has recorded fifteen cases of gunshot fracture involving the knee-joint which he had observed during the same war. In eleven of these recovery took place without suppuration in the joint. In some there was no reaction; in others, a limited amount of swelling and pain took place in the joint, or a trifling suppuration in the external wound.

The brilliant results obtained by Bergmann and Reyher in the Russo-Turkish war, lead us to hope much from the application of antiseptic treatment in gunshot injury of joints. It is necessary to bear in mind, however, that joint-inflammation often sets in very late, especially in wounds of the hip, and doubtless it is sometimes excited by untimely transport in wounds which might otherwise have remained quiescent. Suppuration is, unfortunately, the common consequence of gunshot injury involving an articulation, either from fracture of the joint or a fissure extending into it.

All gunshot injuries of joints are severe, and their danger is in proportion to the extent of the synovial surface. Pyæmia is the almost constant cause of death, amounting to as much as 90 per cent. The mortality after the Franco-German and American wars amounted, for the wrist to about 12, the elbow 20, the ankle 24, the shoulder 33, the knee 50, and the hip 80 per cent.

In all cases where antiseptic occlusion can be resorted to, this method of treatment should be adopted, together with perfect immobilisation of the part. Where inflammatory reaction has already taken place, the joint may still be immobilised, free incisions made into the articulation, all foreign bodies and loose fragments of bone removed, the interior thoroughly disinfected, and efficient drainage provided for. When the damage is too extensive to admit of conservative treatment, excision may be performed or amputation prove necessary. Formerly the universal practice was to amputate in all cases of injury to joints.

External circumstances may sometimes render amputation the better course: want of nursing, long transport, a badly equipped and ventilated field hospital. Of course antiseptic treatment when applied helps to neutralise these. If septic changes have taken place in the wound, amputation is best; secondary incisions and drainage under these circumstances used to prove very fatal. This difficult question must be decided at the first dressing-place—whether a comparatively easy amputation or the more difficult conservative treatment should be adopted. Secondary amputation generally comes too late, and in respect of mortality, as compared with primary amputation, one may say with Hueter: ‘It is as the difference in pulling a sinking man out of the water after one or after ten minutes’ immersion.’

When the occlusive treatment has been begun at the first dressing-place, it should be continued in the field-hospital, unless some pressing contraindication occurs. To realise healing under a scab, the dressing should remain as long as possible without change. When this becomes necessary, fresh pads should be applied. If fever, however, arise with the evening increase of temperature, œdema of the limb, pain in the joint, or rigor, the part must be carefully examined. If the suppuration be not extensive, the joint may be washed out and the wound utilised for drainage purposes, or, if unfavourably placed, a counter-opening may be made. If phlegmonous inflammation be great, the joint must be washed out antiseptically, the plaster splint removed and a posterior splint substituted. If the septic processes be not thus arrested, excision or amputation will become necessary.

In cases where antiseptic drainage has already been adopted, the dressing must be practised only when absolutely necessary, and washing out should be sparingly resorted to. If sepsis sets in, the rules previously laid down are to be followed. In cases of profuse and long-continued suppuration, the joint should be examined for foreign bodies and loose fragments of bone. If the patient arrives at the field-hospital with the joint already in a septic condition, an attempt should be made to purify it, although this may often fail. When the joint-cavity becomes shut off, and the external wound remains open, simple dressings only will be required. Fistulæ may be cleaned with a sharp spoon. Inflammation in the perisynovial tissue, or serous effusion into the joint, may be treated by iodine applications and methodical compression. Passive movements should only be begun, with great caution, after the joint has quite healed and is free from pain. For the after-cure, electricity, douches, and massage must be vigorously carried out.

It may be stated, generally, that in the slighter forms of gunshot injury to the *shoulder*, expectant treatment is justifiable. If a ball be lodged in the head of the humerus, and the bone much comminuted, or if there be considerable damage to the soft parts, primary excision should be performed, unless some additional severe injury contraindicate it. When the attempt to preserve the joint fails and suppuration ensues, the secondary period should be awaited, as no operation should be attempted in the intermediate stage. The after-treatment consists in immobilising the joint until healthy action is set up in the wound, and then an early employment of passive movement. During the Franco-German war ankylosis occurred in rather more than half the number of cases treated conservatively. In 10 per cent. there was free mobility, in the rest more or less impairment of motion. The final results would seem to prove that the function of the limb is better preserved after conservative treatment than it is after excision.

In the *elbow-joint* expectant treatment should, as a rule, be adopted, the mortality being only ten per cent. Excision gives a mortality of rather more than double that, and amputation about the same. In a few instances movement was preserved, but in the great majority ankylosis ensued. During the campaign of 1870 a free use of the joint took place in about 6 per cent. of the cases. Eleven recovered imperfect movement, while in 81 per cent. there was ankylosis. When the limb is in a good position a very useful arm will be the result. The limb should be immobilised on an angular splint, and the wrist kept midway between a position of pronation and supination. Care should be taken to prevent the fingers becoming stiff by early passive motion. Primary excision should be performed in cases of extensive fracture of the bones with injury to the soft parts. It may be either partial or complete. In this case it will be only requisite to remove the portions of bone that are damaged. Complete restoration of function is very rare, but a fair proportion recover, more or less completely, the use of the joint and power over the hand and forearm. In some there was a flail-joint, and many had to be amputated.

Wounds of the *hip-joint* are most severe; expectant treatment is the least dangerous course to pursue. Excision of the hip-joint is only to be performed as a primary operation, and in uncomplicated cases of fracture of the head or neck. The mortality is very great. Amputation at the hip is scarcely justifiable, judging by the terribly fatal consequences following it. Otis states that, in 49 cases of recovery after expectant treatment, in only one was it positively established that a fracture extended into the joint, and he doubts the accuracy of the diagnosis arrived at in many of the others. On the other hand, it would seem that recent experience has been more favourable. Langenbeck records 88 cases of wounds implicating the hip-joint treated expectantly, during the war of 1870, of which 25 recovered. In 39 cases of which the cause of death was known, 34 died from pyæmia and septicæmia. The American reporter pronounces in the most emphatic manner against expectant measures in gunshot fracture of the hip, the mortality of which he estimates amounts to 98·8 per cent. But the writer finds that after primary excision it was 96·9 per cent., and after primary amputation 91·4. Although expectant treatment is therefore, he thinks, to be condemned whenever direct injury to the articulation can be positively affirmed, the margin is very small indeed, and the difficulty of diagnosis admittedly often extreme.

Excision of the *knee-joint* has hitherto been attended with hardly any success in military surgical practice. Formerly amputation for gunshot injury to this joint was the universal rule; now, however, expectant treatment is recognised as the proper course to adopt, especially since the introduction of antiseptic methods. Bergmann reports 33 cases during the Russo-Turkish war, of which 20 made a good recovery and only one died. Sokolow has collected 140 cases of gunshot wound penetrating the knee, of which 100 recovered. If this be even approximately correct, it proves the mortality to be very much less than it ever is after amputation of the thigh. According to Heinzel's table of 117 cases of amputation of the thigh for gunshot injury of the knee, the mortality was 60 per cent. No doubt this list included all the more severe cases. Excision is still more fatal; the percentage of mortality amounted to 86·6 during the American war, and the experience of subsequent campaigns has been the same. We must emphatically pronounce against its performance as a primary operation during a campaign. The results of the excision of the knee performed by Nussbaum at Bazeilles, in 1870, where all but one died, sufficiently endorses this opinion.

Excision of the *ankle*, as a primary operation, is followed by very indifferent success, and, where the injury cannot be treated expectantly, amputation is the preferable course to adopt.

GUNSHOT INJURIES OF THE HEAD.—The proportion of these injuries varies much in different campaigns. It is always in excess in fighting from trenches and during sieges. In the Crimean war, one out of every three men killed in the trenches before Sebastopol was wounded in the head. On the average, injuries of the head constitute about 8 per cent. of all gunshot wounds. According to Gross's statistics, rather less than three-fourths are confined to the scalp, and one-fourth, or rather more, of the cases involve the skull and its contents.

Gunshot injuries of the head may be classified into:—

1. Scalp wounds without lesion of the bone.
2. Contusion of the bone with and without lesion of the scalp.

3. Gunshot fracture involving the outer table alone.

4. Isolated gunshot fracture of the inner table.

5. Gunshot fracture of both tables:—(*a*) Without depression, (*b*) with depression.

6. Gunshot fractures with perforation of the skull and penetration of foreign bodies: (*a*) those in which the projectile escapes, (*b*) those in which the projectile lodges.

Mortality after Injury of the Skull. In the 4,000 cases recorded during the American war the mortality after gunshot fractures of the skull was 60 per cent., while Chenu reckons the mortality in the Crimea at 74 per cent.

In the American report the following results are tabulated of the rate of mortality in different forms of injury:—

	Cases	Mortality
Contusions of the skull . .	328	16·8 p.c.
Fractures of outer table alone .	138	8·7 "
" of inner table alone .	20	95·0 "
Linear fissure of both tables without known depression . .	19	36·8 "
Fracture of both tables without ascertaining depression . .	2911	64·6 "
Depressed fractures . . .	364	35·8 "
Penetrating "	485	85·5 "
Perforating "	73	80·0 "
Ecrasement or smash	9	100·0 "
Contre-coup	2	50·0 "

A total of 4,350 cases, with 2,574 deaths, or about 60 per cent.

The following results followed operative treatment:—

	Cases	Mortality
Extraction of missiles in or within the bone . . .	175	48·3 p.c.
Ligations of bleeding vessels .	33	36·3 "
Removal of bone-splinters or elevation of the bone . .	454	39·0 "
Formal trephining	220	56·6 "
Operations for hernia cerebri . .	29	75·8 "

In regard to trephining, the primary operations were more than twice as fatal as those performed in the later stages. The operations proved most fatal when performed on the frontal bone, a little less in the case of the parietal and occipital, and least in the temporal; but of this last there were but few cases.

In gunshot injuries of the head the damage to the brain is localised, and symptoms of concussion are very rare. Symptoms of compression are more frequent as the result of gunshot injury. Depressed bone is the usual cause; it also occurs as the result of the presence of a foreign body, and from extravasation of blood between the dura mater and skull, upon the surface, or into the substance of the brain. According to Gross, extravasation of blood is the cause of the symptoms in one-half the cases. Hæmorrhage to a greater or less extent is present in every instance of severe fracture of the skull, especially when accompanied by extensive fissuring. The most frequent source of the bleeding is the anterior branch of the middle meningeal artery. This injury is by no means universally fatal. In a few cases trephining over the seat of injury has enabled the surgeon to secure the bleeding points, providing at the same time an escape for coagula. In several instances fractures of the parietal bone, involving laceration of the middle meningeal artery, have been discovered upon post-mortem examination to be united, as in the case of an English officer who was wounded in the parietal region at the storming of the Malakoff. After an interval he became unconscious and hemiplegic. Finally he recovered, but death took place three years later from pneumonia. On examination after death, a united fracture was found in the parietal bone, and a rupture of the middle meningeal artery close to its division into its anterior and posterior branches.

The other causes of compression or interference with brain function are traumatic meningitis or encephalitis. Suppuration occurs in a large number of cases. In about 5 per cent. it is between the dura mater and the bone. It is the result of meningitis in about 25 per cent., and in the form of a localised suppuration or abscess in the substance of the brain in about 70 per cent. of the cases. The symptoms of compression, the result of depressed bone, are often late in making their appearance, and as the result of inflammatory changes seldom arise before the tenth day. When they do occur immediately in cases without manifest depression of skull, they must be due to the extravasation of blood within the cranium. If they supervene within a few hours after the receipt of injury, reactionary hæmorrhage is probably the cause. When they take place after an interval of ten days or longer, they are dependent on inflammatory changes or the formation of an abscess.

The symptoms do not essentially differ from those observed in cases of injury to the skull from other causes. The progress and result depend entirely on the disappearance or removal of the cause. Surgical means may be employed to elevate a depressed portion of bone, remove a foreign body, provide an escape for hæmorrhage, or to seek for and evacuate pus. On the other hand, a blood-clot may become gradually absorbed, and it must be remembered that the brain is able to accommodate itself to a considerable diminution in the capacity of the cranium. The longer the condition of compression is allowed to endure, however, the greater is the risk to the patient's life. *See* Brain, Compression of the.

The symptoms of injury to the brain vary with the position of the wound. In the upper part of the calvaria a gunshot wound of the brain often produces paralysis of the lower extremities; sometimes both upper extremities and the lower of the opposite side are affected. Injury involving the region of the motor centres may produce paralysis of the motor oculi, facial paralysis, or paralysis of groups of muscles in the extremities, consciousness remaining unimpaired. Aphasia may be present, either alone or in association with facial paralysis, or paralysis of the upper extremities may be associated with agraphia. Bergmann, who has devoted much attention to this subject, observed areas of localised loss of sensation after gunshot injury, the motor power remaining intact, especially in injury of the parietal region. Clonic spasm of the muscles, involving certain groups, or sometimes extending over the whole of the opposite side, generally indicates injury to the cortical substance. Paralysis and spasm are alike uncommon after injury involving the occipital and temporal regions. Injury to the medulla oblongata may be recognised by the change in the respiratory function, Cheyne-Stokes respiration, slow pulse, and a sub-normal temperature. When the cerebellum is involved, there will be faulty co-ordination of movement. The paralysis of certain cerebral nerves may serve to localise injury involving the base of the skull. The symptoms, however, are often obscure, and an exact diagnosis will always be difficult to arrive at. Injury to the base or sides of the brain is more dangerous than to the upper surface.

Hernia cerebri is not an uncommon sequence of gunshot injury to the brain. It generally takes place after an interval, and is the result of the increase of intracranial pressure or the formation of abscess. Generally it is small, but it may attain the size of a man's fist. The condition is a very fatal one, 44 patients dying out of the 55 cases recorded during the American war. The majority occurred after the secondary removal of fragments of bone. The diagnosis is easy, as a pulsating tumour, covered by granulation-tissue, is observed projecting from the wound. Simple treatment should be adopted, the surface kept as pure as possible, protected from external injury, and cicatrisation thus promoted. In favourable cases the inflammatory swelling subsides, and the tumour recedes within the skull. A fatal issue is the rule, from extension of the brain-inflammation, or the formation of an abscess, which is so frequently associated with hernia cerebri. The tumour should never be sliced off nor pressure be applied to it. The knife, caustics, or écraseur are alike inapplicable. *See* Hernia Cerebri.

The great majority of gunshot injuries to the brain terminate in a fatal suppurative meningitis. The most common period of its occurrence is from the second to the sixth day after the injury. Bergmann found, however, extensive suppuration actually present in cases which had survived only thirty-six hours. In almost every instance this is associated with septic changes occurring in the wound. At a later period the disease may originate in a suppurative periostitis or ostitis of the broken fragments, thrombosis and phlebitis of one of the sinuses of the dura mater, or in abscess of the brain. The period of its occurrence is quite indefinite.

Cerebral abscess is a common result of gunshot wounds of the head. Most frequently it occurs from two to three weeks after the injury. It may be the consequence of a contusion of the brain, the presence of a foreign body, or more often of purulent inflammation of the skull, or necrosis of a fragment of bone. It may form either in the cortical or white substance, and vary in size from a pigeon's egg to a small orange. The wall of the abscess is irregular, and the contents may be either green, brown, or yellow. The symptoms are indefinite and the diagnosis difficult. Headache is usually present, often of excessive severity; fever, with very irregular exacerbations, and, later on, convulsions and paralysis.

In the treatment of gunshot fracture of the skull, mental and bodily rest is necessary. Transport should be avoided, the secretions regulated, and easily digestible food administered. Simple fractures are, of course, very rare, and must be treated expectantly unless symptoms of compression supervene. In compound fractures antiseptic precautions are of the first importance. Loose fragments should be extracted, and any that are depressed elevated or removed. If a foreign body have penetrated deeply it must be let alone, as the search for it would entail extensive damage to the brain. Projectiles and foreign bodies which can be readily got at should be removed with great care, in order to avoid further injury to the brain or its membranes, or hæmorrhage.

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